

MAMMALS OF SOUTHWESTERN VICTORIA FROM THE LITTLE DESERT TO THE COAST

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ABSTRACT: Mammals in southwestern Victoria were surveyed between 1974 and 1980. Fifty-three species were recorded during the survey period. A further thirteen taxa have probably disappeared from the area since European settlement. The results of our survey, together with previously documented records, are presented as an annotated list of species giving the distribution, abundance and habitat of each species. The recent history and zoogeography of the mammalian fauna is discussed and the mammalian fauna is considered in terms of the distribution of species across five physiographic regions. Most species of small mammal were significantly associated with only one region. The results are used to test the adequacy of the present system of conservation reserves. Most species are adequately catered for. However, further reservations are necessary to protect the remnants of the mammalian fauna of River Red Gum woodland, Yellow Gum woodland and Brown Stringybark open-forest.

Some areas in southwestern Victoria have long been recognized as having high value for the conservation of flora and fauna (Frankenberg 1971) and two areas, the Little Desert and the Lower Glenelg forest have been the subject of land use controversies. Despite this, there have been no systematic surveys of the mammalian fauna of southwestern Victoria, apart from the Grampians-Edenhope area (Emison *et al.* 1978), and few published data are available. Wakefield (1974) summarized data from research collections, the literature and his field work and highlighted the lack of knowledge concerning mammals in western Victoria. Land use reviews by the Land Conservation Council of Victoria (LCC 1972, 1979, 1981a) demonstrated an urgent need for greater knowledge of the status of fauna in the area and inventory surveys of various vertebrate groups were conducted by the Fisheries and Wildlife Division of Victoria (FWD) between October 1974 and July 1980. In this paper we present the results of the mammal survey of the Little Desert, the LCC's South West Study Area, District One and the contiguous area of District Two.

SURVEY AREA

The survey area is bounded to the west by the South Australian border, to the north by the northern edge of the Little Desert (36°25'S), to the south by the Southern Ocean and to the east by 142°E, Glenelg River and eastern boundary of the LCC's South West Study Area, District 1 (Fig. 1). The area so defined (roughly 15 300 km²) is between 180 and 220 km from north to south and between 40 and 92 km from east to west. About 28% of this area is Crown Land, most of which supports native vegetation. Figure 1 shows the distribution of Crown Land and main towns in the survey area.

PHYSIOGRAPHY AND TOPOGRAPHY

Five physiographic regions as defined by Hills (1975) occur in the survey area (Fig. 2). Further details of all except the Little Desert are given by LCC (1972, 1979, 1981a). The Little Desert consists of marine Cainozoic deposits overlain by a veneer of aeolian siliceous sands.

In places Cainozoic red sandstone and ironstone project through the sand sheets forming NW-SE ridges, the most noticeable being the Lawloit Range. In the west and sand sheet is broken by large clay flats. In this region the altitude ranges from 120 to 200 m and the boundary between the Wimmera Plains and the Little Desert is well defined by soil and vegetation changes.

CLIMATE

There is considerable variation in climate in the survey area. The Coastal Plains, Volcanic Plains, Tablelands and Wimmera Plains (except the Mt Arapiles area) have a temperate climate (rainfall more than 500 mm per annum, warm dry summers and wet winters with mild temperatures). The Little Desert and Mt Arapiles have a semi-arid climate (rainfall less than 500 mm per annum, hot dry summers and only moderately wet winters).

Rainfall

Isohyets are shown in Fig. 2; average annual rainfall is greatest near the coast and decreases steadily with increasing distance inland. At Nhill, on the northern edge of the survey area, the average annual rainfall and the winter monthly peaks in rainfall are approximately half those at Portland at the southern tip of the survey area. At Portland, the months May to August produce 50% of the total annual rainfall while further inland rainfall is more evenly distributed throughout the year (Bureau of Meteorology 1975).

Temperature

The average daily range of temperatures increases with distance from the coast. The daily maximum temperatures for January and February are about 10°C higher at Nhill than at Portland while the daily minimum temperatures for June, July and August at Nhill are less than half those at Portland (Bureau of Meteorology 1975). Frosts are more frequent and severe in inland areas and late frosts (September/October) are more likely to occur as are daily maximum temperatures greater than 38°C. The number of months per annum

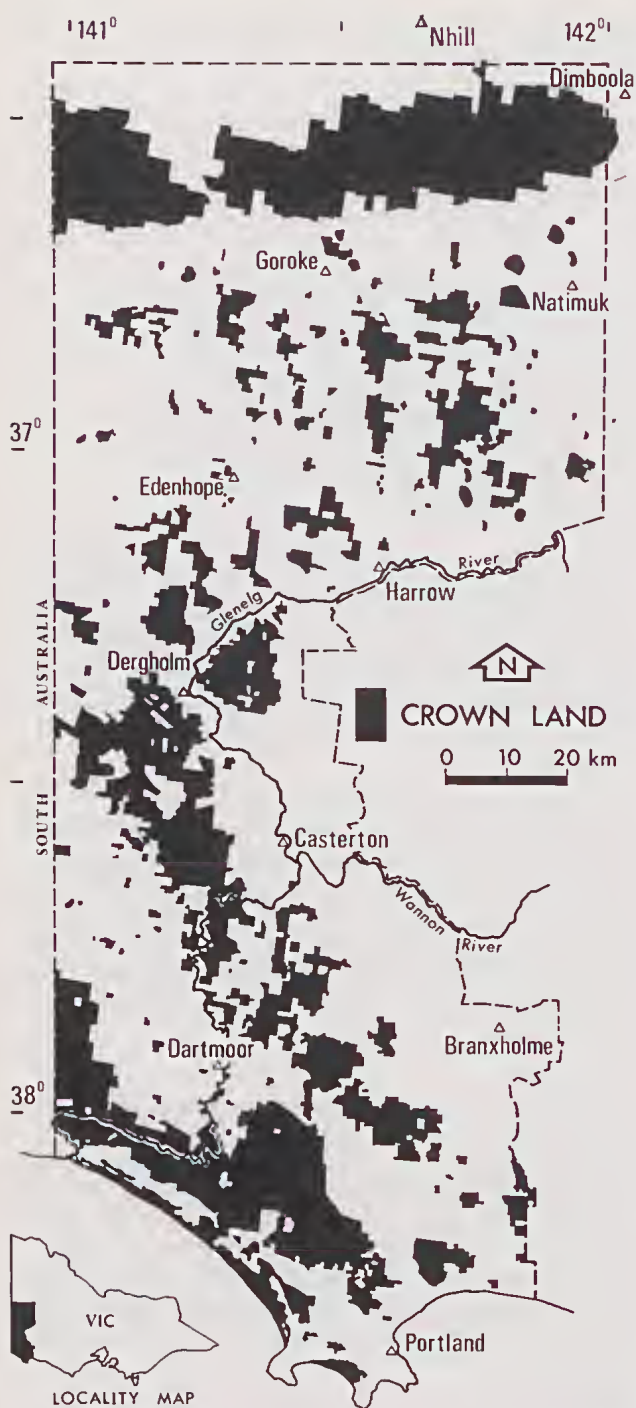


FIG. 1—The survey area showing place names and the distribution of Crown Land.

when effective rainfall (the amount of moisture available for growth of plants after evaporation) is received are: Portland 11, Casterton 9, and Nhill 7 (LCC 1972), thus the growing season for plants is longest in the south.

VEGETATION

There is considerable variation in vegetation from north to south as the climate changes from semi-arid to

cool-temperate. We used 15 plant alliances, based on the classification of Specht *et al.* (1974, Table 7.3), to describe the habitats in the areas surveyed. These are listed below. Further details of the floristic composition, structure and distribution of each alliance are available from the authors and some details can be gleaned from LCC (1972, 1979 and 1981a).

Open-forest

1. Messmate *Eucalyptus obliqua*
2. Manna Gum *E. viminalis*
3. Brown Stringybark *E. baxteri*

Woodland

4. River Red Gum *E. camaldulensis*
5. Yellow Gum *E. leucoxylon*
6. Manna Gum

Low open-forest

7. Brown Stringybark

Closed-scrub

8. Scented Paper-bark *Melaleuca squarrosa*

Open-scrub

9. Broom Honey-myrtle *M. uncinata*
10. Yellow Mallee *Eucalyptus incrassata*
11. Coast Wattle *Acacia sophorae*

Closed-heath

12. Silver Banksia *Banksia marginata*

Open-heath

13. Silver Banksia
14. Desert Banksia *B. ornata*

Closed-grassland

15. Blue Tussock Grass *Poa poiformis*

METHODS

The survey consisted of two parts:

(i) the collation of existing data from museum collections and the literature. This was carried out at the National Museum of Victoria (NMV) (Gedye *et al.* 1979, Evans & Dixon 1980). In addition we examined field notes of previous workers and interviewed local naturalists;

(ii) field surveys to supplement data derived from (i).

Field work took place between October 1974 and April 1975 (Wimmera Plains and Volcanic Plains) and October 1978 and July 1980 (Coastal Plains, remaining areas of Volcanic Plains and Wimmera Plains, and Little Desert) (see Fig. 3). Field trips were held in all months except January and September.

Because of the large area involved (15 300 km²) and time constraints, a primary survey was designed to produce an inventory of terrestrial species, their broad habitat preferences and distribution within a 5' (230 cell) latitude-longitude grid. Emphasis was on areas of Crown Land (28% of the survey area) although all incidental observations on private land were recorded. Figure 3 shows the temporal and geographical distribution of survey effort.

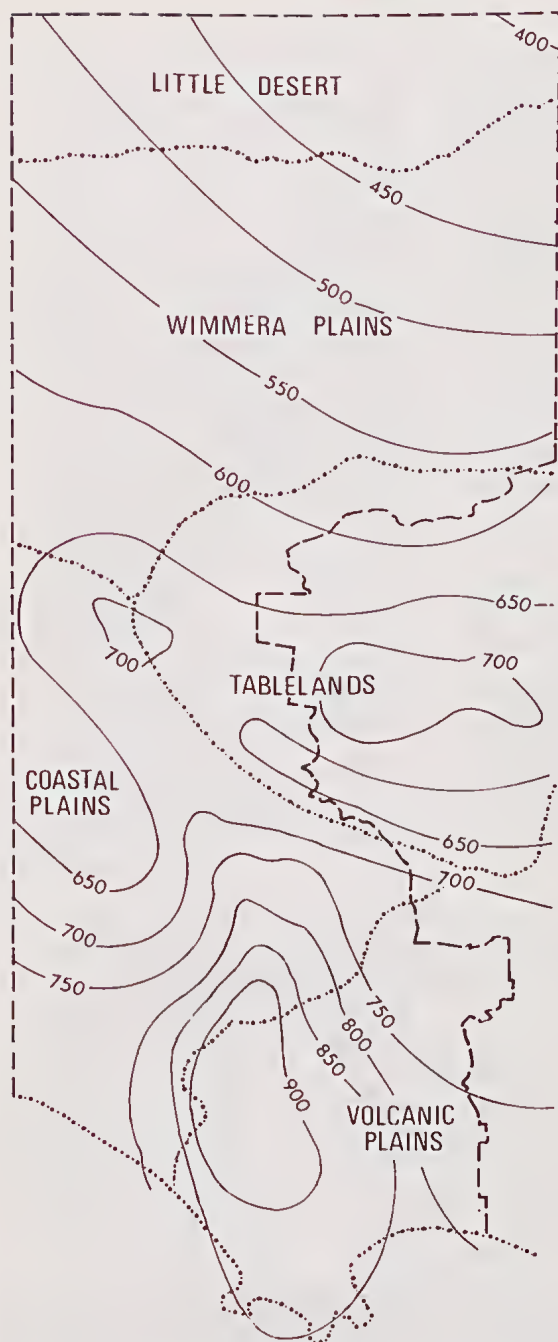


FIG. 2—Isohyets and physiographic regions in the survey area.

Cage Trapping

Cage traps were set in 113 cells and in almost all areas of Crown Land (Fig. 3).

In each 5' cell 20 traps were set in 2 lines of 10, at each of 4 sites and left in place for 2 or more nights giving a minimum of 160 trapnights per cell. Trapping sites were selected to cover a range of vegetation alliances within each cell. Traps were cleared each morning and then reset; they were therefore open day and night. Cap-

tured animals were identified and sexed, their breeding condition was assessed and they were either marked and released or retained as specimens.

Wire cage traps (36 × 20 × 16 cm) were used most of the time but occasionally Elliott type A traps (Elliott Scientific Instruments, Upwey, Victoria) were used. Bait consisted of a mixture of peanut butter, rolled oats and honey.

Drift Fence Pitfall Trapping

Pitfalls with drift fences were used in 15 grids in sandy areas (Fig. 3). Drift fences consisted of PVC Damp Course (0.3 m × 60 m) held up by wire or wooden stakes. Pits consisted of metal tins (20 cm diameter × 28 cm deep) or cylinders (15–25 cm diameter × 45 cm deep) sunk into the soil so that the rim was flush with the soil surface. Eight to ten pits were spaced evenly along the fence and were straddled by it. Pits were not baited and were left in place for 10 nights and checked morning and evening.

Bat Catching

Constantine traps, modified from the design of Tidemann and Woodside (1978), were set in 22 cells (Fig. 3) and fine nylon lines were strung just above the surface of the water of dams (Parnaby 1977) in 4 cells.

Direct Observation

Daylight observations of large mammals (e.g. large macropods *Macropus* spp., Koala *Phascolarctos cinereus*, Common Wombat *Vombatus ursinus*, Fox *Vulpes vulpes* and European Rabbit *Oryctolagus cuniculus*) were made and details of road-killed mammals were also recorded. Night observations were made along tracks from a slowly-moving vehicle using 12 volt spotlights powered by the vehicle battery or on foot using portable 6 volt batteries and lights. Spotlighting took place in 74 cells and in most areas of Crown Land containing mature open-forest or woodland.

Indirect Evidence

Characteristic diggings of 3 species (*Echidna tachyglossus aculeatus*, Common Wombat and European Rabbit); scats of 5 species (Common Brushtail Possum *Trichosurus vulpecula*, Wombat, Dog *Canis familiaris*, Fox and European Rabbit); nests of Common Ringtail Possums *Pseudocheirus peregrinus* and feeding scars of Yellow-bellied Gliders *Petaurus australis* were taken as evidence of the presence of these species.

Mapping

All field, literature and museum records were scrutinised and those accepted are included in the distribution maps presented in Appendix 2. Most records listed by Gedyc *et al.* (1979) and Evans & Dixon (1980) have been accepted but a few which have not are discussed in the Annotated List. All accepted records from any source during our survey (October 1974 to November 1980) are shown by closed circles in the appropriate 5' cell on the distribution maps; those dated before October 1974 are shown by open circles. Records

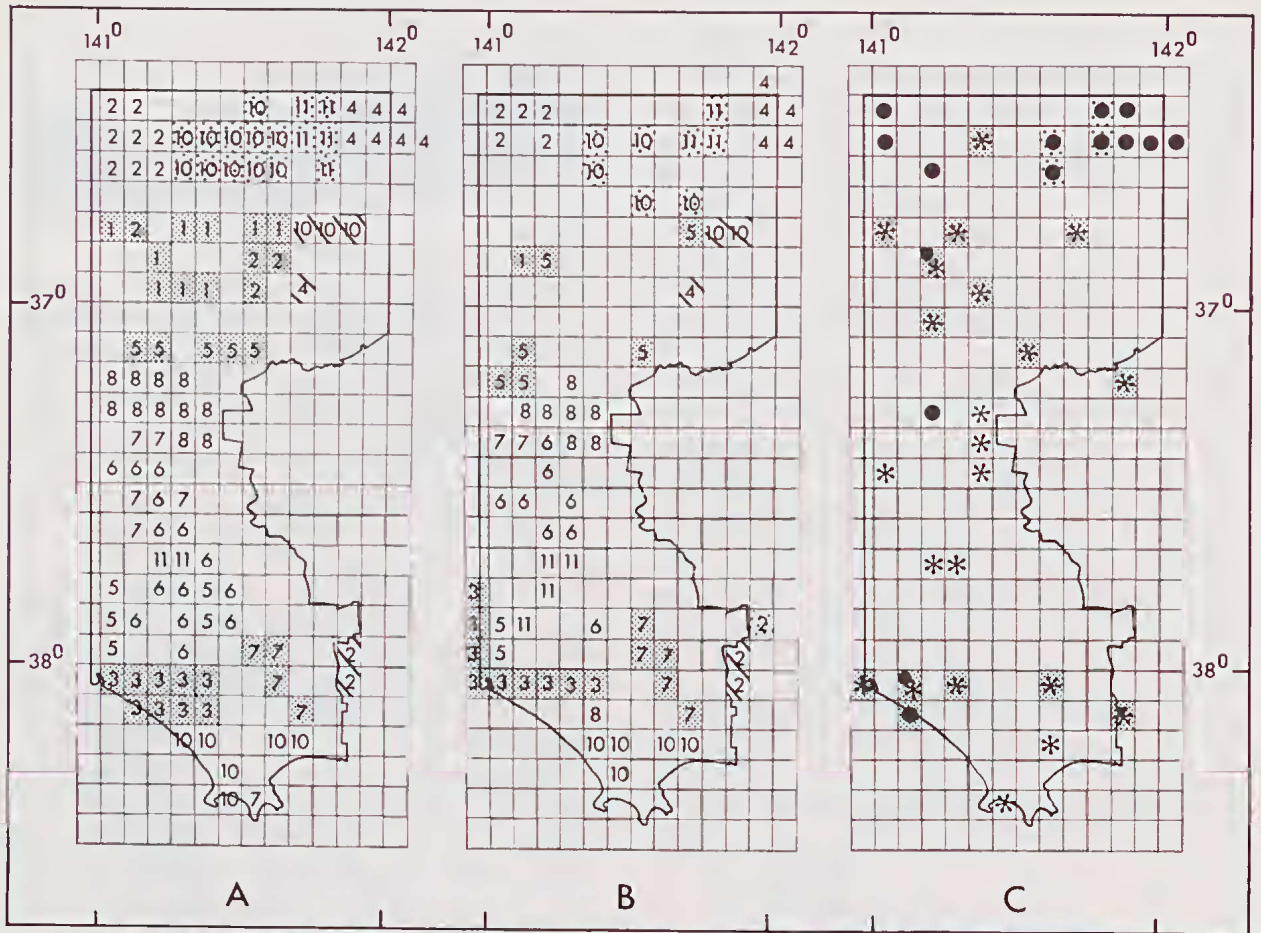


FIG. 3—Temporal and spatial spread of survey effort. Months, years and 5' cells in which cage trapping (A), spotlighting (B), bat trapping (*), and pitfall trapping (●) were conducted. Diagonal lines indicate 1974-1975, open stippling indicates 1978, clear indicates 1979, and close stippling indicates 1980.

with imprecise localities are shown as large circles in the general area of the record.

The distribution maps should be read in conjunction with Fig. 1, showing the distribution of Crown Land which represents most of the remaining timbered areas, and with Fig. 3 showing trapping and spotlighting coverage during the field survey.

Annotated List of Mammals

Summaries of relative abundance, distribution and habitats of each species are given in the Annotated List (Appendix 1). Where appropriate, breeding data, specimen numbers and taxonomic notes are included. For species not recorded during our survey the most recent record is given. All acceptable records of each species are mapped in Appendix 2.

RESULTS

Fifty species of mammal were recorded during our survey (41 native, 9 introduced with feral populations), three others have been recorded in recent years (2 native, 1 introduced) and as many as 12 species and one subspecies may have become extinct since European settlement began in the 1830s (see Discussion). Details of

the abundance, distribution and habitat of each species are presented in the Annotated List.

Forty-nine species have been reported from deposits of late Pleistocene and Recent skeletal material in caves from southwestern Victoria and southeastern South Australia. About half of these species are no longer present in the survey area (Table 1).

Cage Trapping

A total of 17 440 trap nights in 113 5' cells yielded 2045 captures of 20 species of mammals at an overall trapping success rate of 12%. Trapping results for each species are presented in Table 2.

Five species accounted for over 75% of captures (Bush Rat *Rattus fuscipes*, House Mouse *Mus musculus*, Swamp Rat *Rattus lutreolus*, Silky Mouse *Pseudomys apodemoides* and Yellow-footed Antechinus *Antechinus flavipes*) with the Bush Rat accounting for over 33% of all captures.

Trapping rates and diversity of trapped species were highest near the coast and lowest in the Little Desert (Table 3). The latter also produced the lowest trapping rate (2%) of any area surveyed by FWD (unpublished data).

TABLE 1

SPECIES REPRESENTED IN SUB-FOSSIL BONE DEPOSITS FROM WESTERN VICTORIA AND SOUTHEASTERN SOUTH AUSTRALIA

SPECIES	DEPOSITS															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DASYURIDAE																
<i>Antechinus flavipes</i>		●	●													●
<i>A. stuartii</i>	●	●	●		●			●	●	●						●
<i>A. swainsonii</i>	●	●	●		●			●	●							●
<i>Dasyurus maculatus</i>	●			●	●	●	●	●							●	●
* <i>D. viverrinus</i>	●	●	●	●	●	●	●	●					●	●		●
<i>Phascogale tapoatafa</i>	●		●													
* <i>Sarcophilus harrisii</i>	●			●	●	●		●								●
<i>Sminthopsis crassicaudata</i>	●	●	●	●				●								●
<i>S. murina</i>																●
<i>S. leucopus</i>	●	●	●		●			●	●							
* <i>Thylacinus cynocephalus</i>				●				●								●
PERAMELIDAE																
<i>Isodon obesulus</i>	●	●	●	●	●	●		●	●					●	●	●
* <i>Perameles gunnii</i>	●	●	●	●	●	●		●	●					●	●	●
* <i>P. bougainville</i>									●							●
* <i>P. nasuta</i>	●					●		●								
PHALANGERIDAE																
<i>Trichosurus vulpecula</i>	●	●	●	●	●	●	●	●					●	●	●	
BURRAMYIDAE																
<i>Acrobates pygmaeus</i>	●	●						●	●							
<i>Cercartetus nanus</i>	●	●	●					●	●	●						●
PETAURIDAE																
<i>Petaurus breviceps</i>	●	●	●		●			●	●							●
* <i>P. norfolcensis</i>			●													
<i>Pseudocheirus peregrinus</i>	●		●		●	●		●	●							●
MACROPODIDAE																
* <i>Aepyprymnus rufescens</i>	●			●		●		●								
* <i>Bettongia gaimardi</i>	●			●				●	●							●
* <i>B. lesueur</i>				●	●			●								
* <i>B. penicillata</i>																●
* <i>Lagorchestes leporides</i>	●			●				●				●				
<i>Macropus giganteus/fuliginosus</i>	●			●	●	●		●	●			●	●		●	
* <i>M. greyi</i>				●		●		●							●	
<i>M. rufogriseus</i>	●	●	●		●	●	●	●	●			●	●	●	●	
* <i>Onychogalea fraenata</i>				●				●								
* <i>O. unguifera</i>				●												
* <i>Petrogale penicillata</i>			●								●					
* <i>Potorous platyops</i>	●	●		●	●	●	●	●	●							●
<i>P. tridactylus</i>																●
* <i>Thylogale billardieri</i>	●				●	●		●								
* <i>Wallabia bicolor</i>	●							●								
PHASCOLARCTIDAE																
<i>Phascolarctos cinereus</i>								●								
VOMBATIDAE																
<i>Vombatus ursinus</i>	●	●		●		●	●	●				●		●	●	
MURIDAE																
* <i>Conilurus albipes</i>	●	●	●	●				●	●		●					
<i>Hydromys chrysogaster</i>	●			●	●			●								
* <i>Mastacomys fuscus</i>	●	●	●		●		●	●	●							
* <i>Pseudomys australis</i>	●	●	●	●	●		●		●		●					
* <i>P. fumeus</i>								●	●	●						
* <i>P. cf. gracilicaudatus</i>	●	●	●						●	●	●					
* <i>P. cf. novaehollandiae</i>	●	●	●					●	●							
<i>P. shortridgei</i>								●								
* <i>P. sp. nov.</i>		●	●	●	●						●					
<i>Rattus fuscipes greyi</i>	●	●	●					●	●	●						
<i>R. lutreolus</i>	●	●	●	●	●	●		●	●					●		

● present in bone deposits

* no longer present in the survey area

1, Fern Cave (Wakefield 1964). 2, Mt Eeles (Wakefield 1964). 3, Byaduck Caves (Wakefield 1964). 4, Mt Hamilton (Wakefield 1964). 5, Bushfield (Wakefield 1964). 6, Tower Hill Beach (Wakefield 1964). 7, Mt Porndon (Wakefield 1964). 8, McEacherns Cave (Wakefield 1967). 9, Victoria Range (Wakefield 1963). 10, Black Range (Wakefield 1963). 11, Mt Arapiles (Wakefield 1971). 12, Yallum Cave, Penola (Tidemann 1967). 13, Tantanoola Cave (Tidemann 1967). 14, Bat Cave, Naracoorte (Tidemann 1967). 15, Wombat and Cave Park Caves (Maddock 1971). 16, Victoria Cave, Naracoorte (Smith 1971 and 1972).

TABLE 2
RESULTS OF TRAPPING SMALL MAMMALS IN SOUTHWESTERN VICTORIA

Species	Total No. trapped	% of total catch	Cell frequency (%) n=113	No. of trapping sites n=396	Mean trapping success per 100 trapnights where captured (range)
<i>Rattus fuscipes</i>	706	34	46 (41)	121	14 (2-60)
<i>Mus musculus</i>	378	18	60 (53)	104	7 (1-25)
<i>Rattus lutreolus</i>	275	13	37 (33)	68	9 (1-43)
<i>Pseudomys apodemoides</i>	130	6	36 (32)	71	4 (2-13)
<i>Antechinus flavipes</i>	120	6	35 (31)	55	4 (0.5-25)
<i>Pseudomys shortridgei</i>	92	5	24 (21)	41	6 (2-20)
<i>Antechinus swainsonii</i>	69	3	15 (13)	29	5 (1-23)
<i>A. stuartii</i>	67	3	11 (10)	28	5 (1-20)
<i>A. minimus</i>	60	3	15 (13)	22	6 (3-20)
<i>Isodon obesulus</i>	52	3	29 (26)	34	4 (1-15)
<i>Trichosurus vulpecula</i>	37	2	19 (17)	22	3 (1-8)
<i>Rattus rattus</i>	22	1	6 (5)	6	5 (3-8)
<i>Potorous tridactylus</i>	19	1	11 (10)	13	4 (3-8)
<i>Hydromys chrysogaster</i>	8	0.4	2 (2)	2	9 (5-15)
<i>Pseudocheirus peregrinus</i>	3	0.1	3 (3)	3	2
<i>Dasyurus maculatus</i>	2	0.1	1 (1)	2	1
<i>Oryzolaquus cuniculus</i>	2	0.1	2 (2)	2	1 (1-3)
<i>Sminthopsis leucopus</i>	1	0.1	1 (1)	1	2
<i>S. murina</i>	1	0.1	1 (1)	1	2
<i>Cercartetus nanus</i>	1	0.1	1 (1)	1	2
Total	2045				

Pitfall Trapping

Pitfalls yielded only 14 mammals, 9 of which were House Mice. However, these traps caught 2 species not captured in wire cage traps; Fat-tailed Dunnart *Sminthopsis crassicaudata* and Western Pygmy-possum *Cercartetus concinnus*.

Bat Catching

One hundred and forty-seven bats of 11 species were captured (Table 4). Constantine traps captured 117 (79%) of these but trip wires over dams captured 3 species not captured in Constantine traps; White-striped Mastiff-bat *Tadarida australis*, Western Broad-nosed

TABLE 3
SMALL MAMMAL TRAPPING EFFORT AND SUCCESS IN EACH PHYSIOGRAPHIC REGION
Includes only species comprising >1% of total catch.

	Little Desert	Wimmera Plains	Tablelands	Coastal Plains	Volcanic Plains	Overall
Number of trapnights	5470	3076	1502	5240	2150	17440
Number of trapping sites	127	62	28	135	44	396
Total captures	117	308	81	929	593	2028
Percentage of captures comprised by each species within each physiographic region.						
<i>Antechinus flavipes</i>	0	1.3	0.5	1.3	0.1	
<i>A. minimus</i>	0	0	0	1.1	0.1	
<i>A. stuartii</i>	0	0	0	0.2	2.4	
<i>A. swainsonii</i>	0	0	0	0.2	2.8	
<i>Isodon obesulus</i>	0	0.1	0.2	0.8	0.2	
<i>Trichosurus vulpecula</i>	0.02	0.6	0	0.3	0.1	
<i>Potorous tridactylus</i>	0	0	0	0.1	0.6	
<i>Mus musculus</i>	0.6	5.5	2.5	2.0	1.7	
<i>Pseudomys apodemoides</i>	1.5	1.4	0.1	0	0	
<i>P. shortridgei</i>	0	0	0	1.5	0.7	
<i>Rattus fuscipes</i>	0	0.2	1.0	6.0	17.6	
<i>R. lutreolus</i>	0	0.4	1.1	4.0	1.6	
<i>R. rattus</i>	0	0.5	0	0.1	0.1	
Total trapping success (%)	2.1	10.0	5.4	17.7	28	12

Bat *Nycticeius balstoni* and Great Pipistrelle *Pipistrellus tasmaniensis*. *Eptesicus* spp. comprised 69% of all bats captured, followed by Chocolate Wattled Bat *Chalinolobus morio* (8%) and Lesser Long-eared Bat *Nyctophilus geoffroyi* (7%). The small number of sites at which bat trapping took place and variation in bat activity patterns in different seasons and weather conditions preclude a more detailed analysis of trapping results.

Spotlighting

Results of spotlighting arboreal mammals are given in Table 5. Three hundred and twenty-two sightings involving 5 species were made. More than half of these were Common Ringtail Possums although the species was observed in only 36% of cells in which spotlighting took place. Common Brushtail Possums were the most widespread arboreal mammal, being found in 44% of cells where spotlighting occurred.

Observations of arboreal species could not be quantified because of variation in ease of observation in different habitats, in different weather and by different observers. However, species richness of arboreal mammals ranged from 3 species in the Little Desert (Western Pygmy-possum, Sugar Glider *Petaurus breviceps*, and Common Brushtail Possum), to 7 in the open-forests of both the Coastal Plains and the Volcanic Plains (Common Brushtail Possum, Eastern Pygmy-possum *Cercartetus nanus*, Feathertail Glider *Acrobates pygmaeus*, Sugar Glider, Yellow-bellied Glider, Common Ringtail Possum, and Koala). Records of species of Burramyidae were too few to allow comment. However, all other arboreal species are probably common in suitable habitat.

ZOOGEOGRAPHY

Mammal species present in the broad physiographic regions within the survey area and the food niches they

occupy are shown in Table 6. The number of species in the Little Desert was about half that on the Coastal and Volcanic Plains. Greatest differences were in the small ground carnivore and large arboreal herbivore categories (Table 6).

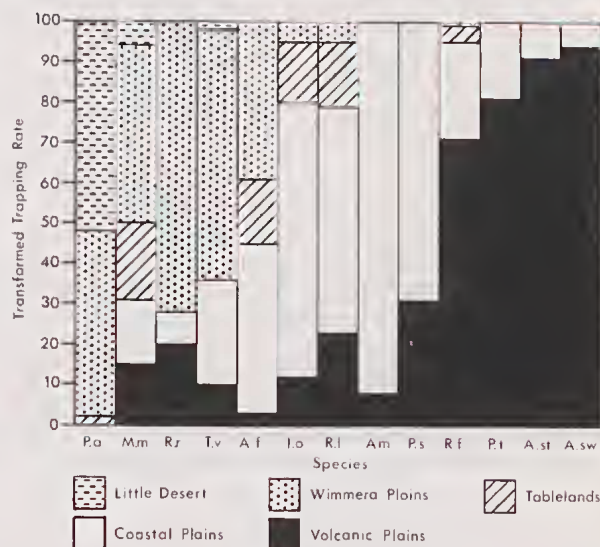


FIG. 4—Comparative trapping rates of each species within each physiographic region. Figures from Table 3 are transformed to a scale of 1 to 100. Species are arranged to show associations of small mammals occurring in each region but trapping rates are not directly comparable between species. P.a.—*Pseudomys apodemoides*, M.m.—*Mus musculus*, R.r.—*Rattus rattus*, T.v.—*Trichosurus vulpecula*, A.f.—*Antechinus flavipes*, I.o.—*Isodon obesulus*, R.l.—*Rattus lutreolus*, A.m.—*Antechinus minimus*, P.s.—*Pseudomys shortridgei*, R.f.—*Rattus fuscipes*, P.t.—*Potorous tridactylus*, A.st.—*Antechinus stuartii*, A.sw.—*Antechinus swainsonii*.

TABLE 4
RESULTS OF TRAPPING BATS IN SOUTHWESTERN VICTORIA

For each species the numbers captured by each method, the percentage frequency in 5' cells sampled and, for Constantine traps, the mean trapping success per night are given.

Species	Number Captured (%) Constantine traps	Lines over dams	Percentage of total catch <i>n</i> = 147	Cell frequency <i>n</i> = 25	Mean trapping success per night where captured (range). Constantine traps only
<i>Tadarida australis</i>	—	3 (10)	2	12	—
<i>T. planiceps</i>	3 (3)	2 (7)	3	16	2 (1-2)
<i>Chalinolobus gouldii</i>	3 (3)	3 (10)	4	16	1 (0.3-1)
<i>C. morio</i>	11 (9)	1 (3)	8	28	1 (0.5-1)
<i>Epiesicus regulus</i>	8 (7)	—	5	12	3 (2-3)
<i>E. sagittula</i>	24 (21)	10 (33)	23	20	6 (1-8)
<i>E. vulturnus</i>	54 (46)	6 (20)	41	60	2 (0.2-8)
<i>Miniopterus schreibersii</i>	2 (2)	—	1	4	2
<i>Myotis adversus</i>	2 (2)	—	1	4	2
<i>Nycticeius balstoni</i>	—	1 (3)	1	4	—
<i>Nyctophilus geoffroyi</i>	10 (9)	—	7	24	1 (0.2-2)
<i>Pipistrellus tasmaniensis</i>	—	4 (13)	3	4	—
Total	117	30	100		

Comparisons of trapping rates of each species of small mammal in each physiographic region were used to investigate the relationship between species abundance and physiographic regions. In Table 3, trapping rates for each physiographic region are transformed into rates for each of the species present. These differences are further illustrated in Fig. 4, where the trapping rates of each species in each physiographic region are compared on a scale of 1 to 100.

The significance of different trapping rates between pairs of physiographic regions having the highest trapping rates for each species are shown in Table 7. All species except the Yellow-footed Antechinus and Silky Mouse were significantly associated with a single region.

DISCUSSION

RECENT HISTORY OF THE MAMMALIAN FAUNA

The mammalian fauna of the survey area has changed dramatically since the Pleistocene. Species represented in Late Pleistocene and Recent bone deposits from caves in western Victoria and southeastern South Australia are listed in Table 1. About half the 49 taxa listed are no longer present in the area. Reasons for this decline in species diversity are not clear as the difficulties of accurately ageing bone deposits (e.g. Wakefield 1967, 1969) and problems of interpretation (Calaby 1971)

preclude detailed analysis. Several taxa, which may have been present at the time of European settlement (1830-1880) have disappeared. These include Eastern Quoll *Dasyurus viverrinus*, Red-bellied Pademelon *Thylogale billardieri*, Brush-tailed Bettong *Bettongia penicillata*, Eastern Hare Wallaby *Lagorchestes leporides*, Bridled Nailtail Wallaby *Onychogalea fraenata*, Toolache Wallaby *Marcopus greyi*, Swamp Wallaby *Wallabia bicolor*, Rabbit-eared Tree-rat *Conilurus albipes*, and Dingo *Canis familiaris dingo* (Wakefield 1974). Cockburn (1979) believes a further 4 rodent species were also probably present at that time but are no longer extant in the area. These were: Broad-toothed Rat *Mastacomys fuscus*, Plains Mouse *Pseudomys australis*, New Holland Mouse, *P. novaehollandiae* and an undescribed *Pseudomys*.

The decline of these taxa was probably due to various combinations of the effects of land clearance, grazing of stock, changed fire regimes, the introduction and subsequent effects of European Rabbits, and general persecution. The writings of some early settlers describe how the fauna of the Wimmera Plains declined in the face of European settlement. In the 1860s Edward Townsend described, amongst others, 'Wallabies, Kangaroo-rats, Native Cats and Dingoes' as occurring in the Nhill area (Blake 1976, p. 2). Of these only the Red-necked Wallaby *Macropus rufogriseus* occurs there now and it is rare. In 1861 William Lockhart Morton travelled north from Antwerp to Pine Plains and beyond (north of our survey area). He described 'Kangaroos, Wallabies, Paddymelons and Kangaroo-rats' (An Old Bushman 1861). From his descriptions of their behaviour these may have included the Western Grey Kangaroo *Macropus fuliginosus*, Bridled Nailtail Wallaby or Eastern Hare Wallaby, and Brush-tailed Bettong. Sub-fossil remains of Bridled Nailtail Wallaby were reported from Lake Hindmarsh in 1959 (Wakefield 1966). No small macropods are mentioned by subsequent naturalists who visited the area (e.g. Le Souef 1887, French 1888a, Le Souef 1893, Campbell 1899)

TABLE 5
RESULTS OF SPOTLIGHTING FOR ARBOREAL MAMMALS IN
SOUTHWESTERN VICTORIA

Species	Total number observed	% of all observations (%)	Cell frequency (%) <i>n</i> = 74
<i>Trichosurus vulpecula</i>	127	37	44 (59)
<i>Petaurus australis</i>	21	6	10 (13)
<i>Petaurus breviceps</i>	7	2	6 (8)
<i>Pseudocheirus peregrinus</i>	178	52	27 (36)
<i>Phascogalea cinereus</i>	8	3	6 (8)
Total	341	100	

TABLE 6

COMPARISON OF FOOD NICHES OCCUPIED BY EACH SPECIES AND THE PHYSIOGRAPHIC REGIONS IN WHICH THEY OCCUR

Food niche	Species	Physiographic region				
		LD	WP	T	CP	VP
CARNI VORE						
Large Ground	<i>Dasyurus maculatus</i>					X
Small Soil Fossicking	<i>Tachyglossus aculeatus</i>	X	X	X	X	X
	<i>Sminthopsis crassicaudata</i>	X	X	X		
	<i>S. murina</i>		X	X		
	<i>S. leucopus</i>				X	X
	<i>Antechinus swainsonii</i>				X	X
	<i>A. minimus</i>				X	X
	<i>Isodon obesulus</i>				X	X
	<i>Potorous tridactylus</i>					X
Small Scansorial	<i>Antechinus flavipes</i>		X	X	X	
	<i>A. stuartii</i>				X	X
	<i>Phascogale tapoatafa</i>		X	X		
Small Aerial	<i>Tadarida australis</i>	X	X	X		
	<i>T. planiceps</i>	X	X			
	<i>Chalinolobus gouldii</i>	X	X	X	X	X
	<i>C. morio</i>	X	X		X	X
	<i>Eptesicus</i> spp	X	X	X	X	X
	<i>Miniopteris schreibersii</i>				X	X
	<i>Myotis advenus</i>			X		
	<i>Nycticeius balstoni</i>	X	X			
	<i>Nyctophilus geoffroyi</i>	X	X	X	X	X
	<i>Pipistrellus tasmaniensis</i>				X	
OMNI VORE						
Large Ground	<i>Vulpes vulpes</i>	X	X	X	X	X
Small Ground	<i>Mus musculus</i>	X	X	X	X	X
	<i>Rattus rattus</i>		X		X	X
	<i>R. fuscipes</i>			X	X	X
Large Arboreal	<i>Trichosurus vulpecula</i>	X	X	X	X	X
	<i>Petaurus breviceps</i>	X	X	X	X	X
Small Arboreal	<i>Cercartetus concinnus</i>	X	X			
	<i>C. nanus</i>					X
	<i>Acrobates pygmaeus</i>		X	X	X	X
HERBI VORE						
Large Ground	<i>Macropus fuliginosus</i>	X	X			
	<i>M. giganteus</i>				X	X
	<i>M. rufogriseus</i>	X	X		X	X
	<i>Vombatus ursinus</i>				X	
Small Ground	<i>Oryctolagus cuniculus</i>		X	X	X	X
	<i>Lepus capensis</i>		X	X	X	X
	<i>Pseudomys apodemoides</i>	X	X			
	<i>P. shortridgei</i>				X	X
	<i>Rattus lutreolus</i>			X	X	X
Large Arboreal	<i>Pseudocheirus peregrinus</i>		X	X	X	X
	<i>Petaurus australis</i>				X	X
	<i>Phascolarctos cinereus</i>				X	X
Small Arboreal	<i>Pteropus scapulatus</i>		X			X
Totals (%)	44	17 (39)	26 (59)	20 (45)	30 (68)	31 (70)

LD - Little Desert, WP - Wimmera Plains, T - Tablelands, CP - Coastal Plains,

VP - Volcanic Plains

TABLE 7
SIGNIFICANCE OF DIFFERENCES IN TRAPPING RATES BETWEEN
PHYSIOGRAPHIC REGIONS

Only the 2 regions with the highest trapping rates for each species are compared. Values in parentheses are the number of captures in each region. LD-Little Desert (5470 trap nights), WP-Wimmera Plains (3076), T-Tablelands (1502), CP-Coastal Plains (5240), VP-Volcanic Plains (2150).

Species	Physiographic regions compared	χ^2 value	Significance level
<i>Antechinus flavipes</i>	WP:CP (39:71)	0.2	NS
<i>A. minimus</i>	CP:VP (58:2)	18.7	0.001
<i>A. stuartii</i>	CP:VP (13:54)	89.1	0.001
<i>A. swainsonii</i>	CP:VP (10:59)	109.7	0.001
<i>Isodon obesulus</i>	T:CP (3:44)	7.3	0.01
<i>Trichosurus vulpecula</i>	WP:CP (20:14)	6.6	0.01
<i>Potorous tridactylus</i>	CP:VP (7:12)	13.3	0.005
<i>Mus musculus</i>	WP:T (168:37)	21.5	0.001
<i>Pseudomys apodemoides</i>	LD:WP (85:44)	0.3	NS
<i>P. shortridgei</i>	CP:VP (78:14)	8.0	0.005
<i>Ratus fuscipes</i>	CP:VP (316:368)	213.5	0.001
<i>R. lutreolus</i>	CP:VP (211:35)	24.8	0.001
<i>R. rattus</i>	WP:VP (16:3)	4.7	0.05

although French (1888) says that he saw hardly any small mammals 'save a large Paddy-melon and a couple of Kangaroo-rats' [possibly Bridled Nailtail Wallaby and Brush-tailed Bettong]. These species would have inhabited woodland and disappeared soon after selectors moved into the Wimmera Plains with their flocks of sheep in the 1840s and 1850s. Wholesale clearing of woodlands and mallee for crops took place in the 1880s and the concurrent plagues of European Rabbits (Campbell 1884, French 1888, 1888a, Rolls 1969, p. 37) may have hastened the decline of the small macropods through competition for food and shelter. Details of the introduction and spread of European Rabbits are given in the Annotated List. Dingoes were poisoned with strychnine from the time sheep were first grazed in the area (Le Souef 1887, French 1888, D'Alton 1913) and Eastern Quolls may have suffered by taking baits laid for Dingoes. Marlow (1958) has noted a similar decline in the marsupial fauna of New South Wales, particularly the small marsupials of the woodlands and plains, during the late 19th century.

ZOOGEOGRAPHY OF THE PRESENT FAUNA

Trapping rates obtained in this survey (20 species trapped at a success rate of 12%) were greater than or similar to results from previous FWD surveys in areas of similar size (e.g. North Central Victoria, 6 species trapped, 20% success rate (Menkhorst & Gilmore 1979) or Gippsland Lakes Catchment, 19 species trapped, 14% success rate (FWD unpublished data). This diverse mammal fauna reflects the broad range of habitats present, a consequence mainly of the wide variation in rainfall and soil types from north to south. Table 6 il-

lustrates the increasing diversity of species towards the coast and the food niches occupied in each physiographic region. On the Volcanic Plains and Coastal Plains several species from all food niches were present. Data for the Tablelands are lacking due to the lack of native vegetation. However, at least one species from each food niche was recorded. The Wimmera Plains had fewer species of small ground and scansorial carnivores and only one large arboreal herbivore while the Little Desert was depauperate in small ground and scansorial carnivores, small ground omnivores, small ground herbivores and arboreal herbivores.

The trend of reducing species richness from the coast inland is not continued, in the case of small mammals, in the Big Desert to the north of our survey area. Four small mammal species occur there but not in the Little Desert; two small ground carnivores (*Ningaui* sp., Mouse Dunnart *Sminthopsis murina*), one small arboreal omnivore (Little Pygmy-possum *Cercartetus lepidus*) and one small ground herbivore (Mitchell's Hopping-mouse *Notomys mitchellii*). Reasons for the depauperate small mammal fauna in the Little Desert are not clear as the floristically rich heath communities should result in a reliable food source for small herbivores and small carnivores and the climate is not as severe as in the Big Desert.

The associations between species of small mammals and physiographic regions, as revealed by comparisons of trapping rates, are shown in Fig. 4 and Table 7. The Silky Mouse was captured at similar rates in the Little Desert and Wimmera Plains and the Yellow-footed Antechinus in the Wimmera Plains and Coastal Plains.

TABLE 8
MAJOR EXISTING AND PROPOSED CONSERVATION RESERVES IN
SOUTHWESTERN VICTORIA
There are approximately 428 400 ha of Crown Land in the
survey area.

Reserve	Area (ha)	Physiographic region
Little Desert National Park	35300	Little Desert
Lower Glenelg National Park	27300	Coastal Plains
Jilpanger Flora and Fauna Reserve (proposed)	8990	Wimmera Plains
Discovery Bay Coastal Park	8450	Coastal Plains
Mt Eccles State Park	6200	Volcanic Plains
Mt Arapiles-Tooon State Park (proposed)	4860	Wimmera Plains
Tooloy-Lake Mundi Game Reserve	4012	Coastal Plains
Mt Richmond National Park	1707	Volcanic Plains
Baileys Rocks Scenic and Recreation Reserve	489	Coastal Plains
Bats Ridges Faunal Reserve	324	Volcanic Plains
Cape Nelson State Park	210	Volcanic Plains
Total	97842	

TABLE 9
AREAS OF CONSERVATION RESERVES IN EACH PHYSIOGRAPHIC REGION
Figures in parentheses are the percentages of Crown Land in conservation reserves within each region.

Region	Area reserved (ha)	Percentage of total reserved area in Southwestern Victoria
Little Desert	35300 (22)	36
Wimmera Plains	13850 (46)	14
Tablelands	0	0
Coastal Plains	40251 (30)	41
Volcanic Plains	8442 (12)	9
Totals	97842	100

The Brown Antechinus *Antechinus stuartii*, Dusky antechinus *A. swainsonii*, Long-nosed Potoroo *Potorous tridactylus*, and Bush Rat were all trapped at significantly higher rates on the Volcanic Plains where the vegetation is predominantly Messmate open-forest and Manna Gum open-forest and the rainfall is the highest in the survey area (Fig. 2).

The Swamp Antechinus *A. minimus*, Short-nosed Bandicoot *Isodon obesulus*, Swamp Rat, and Heath Mouse *Pseudomys shortridgei* were significantly associated with the Coastal Plains where they occur in the extensive heathlands and Brown Stringybark open-forest with a heath understory.

On the Wimmera Plains the two introduced rodents House Mouse and Black Rat *Rattus rattus* were trapped at higher rates than elsewhere, as was the Common Brushtail Possum. The predominance of the two introduced rodents probably reflects the greater extent of disturbance of the native vegetation in this region.

CONSERVATION RESERVES

Conservation reserves are defined here as any area of Crown Land having flora and fauna conservation as a primary management aim and being large enough to maintain communities of mammals. Areas used for hardwood or softwood production and the numerous small wetland reserves are excluded from the following discussion.

About 98 000 ha of Crown Land (23%) in the survey area is held in existing or proposed conservation reserves (LCC 1973, 1981, Ministry for Conservation 1981) (Table 8). This proportion of Crown Land held in conservation reserves is similar to that in most areas for which the LCC has produced Final Recommendations. However, the proportion for each physiographic region varies from 12% on the Volcanic Plains to 46% on the Wimmera Plains (Table 9). Further reserves are justified on the Volcanic Plains where most Crown Land is now used for hardwood production.

Most vegetation alliances are well represented within the present reserve system. However, River Red Gum woodland, Yellow Gum woodland and Brown Stringybark open-forest are inadequately catered for despite the fact that Brown Stringybark open-forest supports more mammal species than any other alliance and the two woodland alliances each support more than 40% of species (data from Appendix 1). The two woodland alliances occurred extensively on the Wimmera Plains, Tablelands and northern Coastal Plains but were cleared to form prime grazing and cropping country. The small areas of woodland remaining on Crown Land are now used for hardwood production threatening the existence of one species (*Tuan Phascogale tapoatafa*) in the survey area. The extensive areas of Brown Stringybark open-forest north and west of the Glenelg River are only reserved in Tooloy-Lake Mundi Game Reserve yet this alliance supports a diverse small mammal fauna consisting of Yellow-footed Antechinus, Swamp Antechinus, Short-nosed Bandicoot, Bush Rat, Swamp Rat, Silky Mouse and Heath Rat. This fauna is transitional between those of the Desert Banksia open-heaths of the Wimmera Plains and the wetter Silver Banksia closed-heaths near the coast. Further reserves of all 3 alliances are necessary to adequately cater for the range of mammals in the survey area.

ACKNOWLEDGEMENTS

We are grateful to the following for assistance in collecting field data: Fisheries and Wildlife Division: G. Apps, W. Bren, K. Cherry, S. Craig, D. Deerson, W. Emison, A. Gilmore, D. Hespe, G. Horrocks, J. Marcic, K. Norris, M. O'Sullivan, J. Porter, J. Seebeck,

TABLE 10
HABITAT PREFERENCE OF *Mus musculus* AND *Pseudomys apodemoides* IN THE LITTLE DESERT
Combined trapping data from October to November 1978 and February and April 1979.

Habitat	Number of sites	Percentage of sites where trapped		Mean trapping success per 100 trapnights	
		<i>P.</i>	<i>M.</i>	<i>P.</i>	<i>M.</i>
		<i>apodemoides</i>	<i>musculus</i>	<i>apodemoides</i>	<i>musculus</i>
Desert Banksia open-heath	20	55	15	2	1
Yellow Mallee open-serub	3	33	0	1	
Broom Honey-myrtle open-serub	21	52	10	2	0.3
Brown Stringybark low open-forest	40	65	12	2	1
Yellow Gum woodland	24	0	20		1
Red Gum woodland	3	0	100		5

and I. Temby; National Museum of Victoria: A. Coventry, A. Gedy, and R. Wilson; National Herbarium: Dr. P. Gullan, D. Parkes, and N. Walsh. J. Alexander and R. Adair also assisted. Information from personal files and records was provided by C. Brownsea (National Parks Service), G. Cerini (FWD), A. Cockburn (Monash University), C. Crouch (Nhill), J. Davies (NPS), K. Hateley (Kiata), R. Howlett (Dergholm), P. Kelly (FWD), W. Middleton (Forests Commission Victoria), R. and P. Reichelt (Nhill), F. Rogers (Quantong), J. Seebeck (FWD), and R. Warneke (FWD).

The collations of museum specimens and literature records carried out at the NMV (Gedy *et al.* 1979, Evans & Dixon 1980) were a major source of information and saved much tedium. P. Aitken provided lists of relevant specimens held in the South Australian Museum.

A. F. Bennett, W. B. Emison, Dr. F. I. Norman, and J. H. Seebeck kindly commented on drafts of this paper. J. Marcius helped with proof reading.

REFERENCES

- AN OLD BUSHMAN [William Loekhart Morton], 1861. Notes of a tour in the Wimmera District. *The Yeoman and Australian Acclimatiser* Vol. 1.
- ANONYMOUS, 1846. Miscellanea. *The Tasmanian Journal* 2: 460.
- ANONYMOUS, 1907. Natural History Note. *Victorian Nat.* 23: 243.
- AUSTRALIAN MAMMAL SOCIETY, 1980. Recommended common names of Australian mammals. *Aust. Mamm. Soc. Bull.* 6(2): 13-23.
- BENTLEY, A., 1978. *An introduction to the Deer of Australia with special reference to Victoria* (Revised ed.). Koetong Trust Service Fund, Forests Commission Victoria, Melbourne.
- BLAKE, L., 1976. *The Land of the Lowan: 100 Years in Nhill and West Wimmera*. Nhill and District Historical Society, Nhill.
- BRAITHWAITE, R. W., 1980. The ecology of *Rattus lutreolus*. II. Reproductive tactics. *Aust. Wildl. Res.* 7: 53-62.
- BRAITHWAITE, R. W., COCKBURN, A. & LEE, A. K., 1978. Resource partitioning by small mammals in lowland heath communities of south-eastern Australia. *Aust. J. Ecol.* 3: 423-445.
- BRAITHWAITE, R. W. & LEE, A. K., 1979. The ecology of *Rattus lutreolus*. I. A Victorian heathland population. *Aust. Wildl. Res.* 6: 173-189.
- BRAITHWAITE, R. W. & LEE, A. K., 1979a. A mammalian example of semelparity. *American Nat.* 113: 151-5.
- BRAZENOR, C. W., 1936. Muridae recorded from Victoria. *Mém. Natn. Mus. Melb.* 10: 62-85.
- BRAZENOR, C. W., 1958. Mitchells Hopping Mouse. *Proc. R. Zool. Soc. NSW* (1956-7): 19-22.
- BUREAU OF METEOROLOGY, 1975. *Climatic Averages Australia*. Metric ed. Aust. Government Publishing Service, Canberra.
- CALABY, J. H., 1971. Man, fauna and climate in aboriginal Australia. In *Aboriginal Man and Environment in Australia*, Mulvaney, D. J. and Galson, J., eds, ANU Press, Canberra.
- CAMPBELL, A. J., 1884. Mallee Hens and their Egg Mounds. *Victorian Nat.* 1: 124-129.
- CAMPBELL, A. J., 1899. Field notes from the lower Wimmera. *Victorian Nat.* 16: 121-131, 149-158.
- COCKBURN, A., 1979. The ecology of *Pseudomys* spp. in south-eastern Australia. PhD Thesis, Monash University, (unpubl.).
- COCKBURN, A., 1981. Diet and habitat preference of the Silky Desert Mouse, *Pseudomys apodemoides* (Rodentia). *Aust. Wildl. Res.* 8: 475-497.
- COCKBURN, A., 1981a. Population processes of the Silky Desert Mouse *Pseudomys apodemoides* (Rodentia), in mature heathland. *Aust. Wildl. Res.* 8: 499-514.
- COCKBURN, A., BRATHWAITE, R. W. & LEE, A. K., 1981. The response of the Heath Rat, *Pseudomys shortridgei*, to pyric succession: a temporally dynamic life-history strategy. *J. Anim. Ecol.* 50: 649-666.
- D'ALTON, ST ELROY, 1913. The botany of the Little Desert, Wimmera, Victoria. *Victorian Nat.* 30: 65-78.
- DWYER, P. D., 1970. Foraging of the Australian Large-footed Myotis (Chiroptera). *Mammalia* 34: 76-80.
- DWYER, P. D. & HAMILTON-SMITH, E., 1965. Breeding caves and maternity colonies of the Bent-winged Bat in south-eastern Australia. *Helicite* 4: 3-21.
- EMISON, W. B., PORTER, J. W., NORRIS, K. C. & APPS, G. J., 1978. Survey of the vertebrate fauna in the Grampians-Edenhope area of southwestern Victoria. *Mém. natn. Mus. Vict.* 39: 281-363.
- EVANS, S. & DIXON, J. M., 1980. *Report on the mammalian fauna of the South Western Study Area (District 1)*. Mammal Dept., National Museum of Victoria, Melbourne.
- FINLAYSON, H. H., 1927. Observations on the South Australian members of the subgenus "Wallabia". *Trans. R. Soc. S. Aust.* 51: 363-377.
- FINLAYSON, H. H., 1944. A further account of the murid, *Pseudomys (Gyomys) apodemoides* Finlayson. *Trans. R. Soc. S. Aust.* 68: 210-224.
- FRANKENBERG, JUDITH, 1971. *Nature Conservation in Victoria: a survey*. Victorian National Parks Association, Melbourne.
- FRENCH, CHARLES, 1888. Notes on the Zoology of Lake Albacutya District. *Victorian Nat.* 5: 35-42.
- FRENCH, C., 1888a. Notes on the natural history of the western Wimmera. *Victorian Nat.* 5: 145-152.
- GEDYE, A., WILSON, R., DIXON, J. M. & HUXLEY, L., 1979. *Report on the mammalian fauna of the Wimmera, Victoria*. Mammal Dept., National Museum of Victoria, Melbourne.
- HALL, K. S. & RICHARDS, G. C., 1979. *Bats of Eastern Australia*. Queensland Museum Booklet No. 12, Brisbane.
- HAMILTON, J. C., 1914. *Pioneering Days in Western Victoria*. Exchange Press, Melbourne.
- HAMILTON-SMITH, E., 1965. Distribution of cave-dwelling bats in Victoria. *Victorian Nat.* 82: 132-137.
- HAPPOLD, M., 1976. Reproductive biology and development in the conilurine rodents (Muridae) of Australia. *Aust. J. Zool.* 24: 19-26.
- HILLS, E. S., 1975. *The Physiography of Victoria*. Whitcombe and Tombs, Melbourne.
- JONES, F. W., 1924. *The Mammals of South Australia. Pt. 2 Bandicoots and the Herbivorous Marsupials*. Government Printer, Adelaide.
- KEILLER, H., 1940. Wildlife of Portland. *B.O.C. Monthly Notes* (Aug.).
- LAND CONSERVATION COUNCIL OF VICTORIA, 1972. *Report on the South West Study Area, District 1*. Government Printer, Melbourne.

- LAND CONSERVATION COUNCIL OF VICTORIA, 1973. *Final Recommendations, South-western Study Area, District 1*. Government Printer, Melbourne.
- LAND CONSERVATION COUNCIL OF VICTORIA, 1979. *Report on the South West Study Area, District 2*. Government Printer, Melbourne.
- LAND CONSERVATION COUNCIL OF VICTORIA, 1981. *Proposed Recommendations, South-western Area, District 2*. Government Printer, Melbourne.
- LAND CONSERVATION COUNCIL OF VICTORIA, 1981a. *South-western Area, District 1—Review*. Government Printer, Melbourne.
- LE SOUEF, D., 1887. Trip to Lake Albacutya. *Victorian Nat.* 4: 44-47.
- LE SOUEF, D., 1893. Notes on a visit to the Ebenezer Mission Station. *Victorian Nat.* 10: 123-128.
- LE SOUEF, J. C., 1965. Acclimatization in Victoria. *The Victorian Historical Magazine* 36: 8-29.
- MADDOCK, T. H., 1971. Some mammal remains from caves in the Naracoorte area. *S. Aust. Nat.* 46: 24-27.
- MAHONEY, J. A., 1982. Identities of the rodents (Muridae) listed in T. L. Mitchell's "Three Expeditions into the Interior of Eastern Australia, with Descriptions of the Recently Explored Region of Australia Felix, and of the Present Colony of New South Wales". *Aust. Mamm.* 5: 15-36.
- MARLOW, B. J., 1958. A survey of the marsupials of New South Wales. *CSIRO Wildl. Res.* 3: 71-114.
- McKEAN, J. L. & HALL, L. S., 1965. Distribution of the Large-footed Myotis, *Myotis adversus*, in Australia. *Victorian Nat.* 82: 164-168.
- McKEAN, J. L., RICHARDS, G. C. & PRICE, W. J., 1978. A taxonomic appraisal of *Eptesicus* (Chiroptera: Mammalia) in Australia. *Aust. J. Zool.* 26: 529-537.
- MENKHORST, P. W. & GILMORE, A. M., 1979. Mammals and reptiles of North Central Victoria. *Mem. natn. Mus. Vict.* 40: 1-33.
- MINISTRY FOR CONSERVATION, 1981. *A guide to the Ministry for Conservation*. 3rd ed., Government Printer, Melbourne.
- MORTON, S. R., 1978. An ecological study of *Sminthopsis crassicaudata* (Marsupialia: Dasyuridae). III. Reproduction and life history. *Aust. Wildl. Res.* 5: 183-212.
- MORTON, S. R., WAINER, J. W. & THWAITES, T. P., 1980. Distribution and habitats of *Sminthopsis leucopus* and *S. murina* (Marsupialia: Dasyuridae) in south-eastern Australia. *Aust. Mamm.* 3: 19-30.
- NEWSOME, A. E., 1969. A population study of house-mice temporarily inhabiting a South Australian wheatfield. *J. Anim. Ecol.* 38: 341-359.
- N. F. L. [NOEL LEARMONTH] 1947. Random Notes. *Portland Guardian* 28 May, 1947.
- NORRIS, K. C., GILMORE, A. M. & MENKHORST, P. W., 1979. Vertebrate fauna of South Gippsland, Victoria. *Mem. natn. Mus. Vict.* 40: 105-199.
- PARNABY, H., 1977. Bat survey of the Daylesford area, Victoria. *Victorian Nat.* 94: 191-197.
- POOLE, W. E., 1973. A study of breeding in Grey Kangaroos, *Macropus giganteus* Shaw and *M. fuliginosus* (Desmarest), in central New South Wales. *Aust. J. Zool.* 21: 183-212.
- POOLE, W. E., 1977. The Eastern Grey Kangaroo, *Macropus giganteus*, in South-east South Australia: its limited distribution and need of conservation. *CSIRO Div. Wildl. Res. Tech. Pap.* No. 31.
- POOLE, W. E., CARPENTER, S. M. & SIMMS, N. G., 1980. Multivariate analyses of skull morphometrics from the two species of Grey Kangaroos, *Macropus giganteus* Shaw and *M. fuliginosus* (Desmarest). *Aust. J. Zool.* 28: 591-605.
- ROBINSON, A. C., 1976. Population ecology of *Rattus fuscipes* Waterhouse (Muridae: Rodentia). PhD Thesis, Monash University (unpubl.).
- ROLLS, E. C., 1969. *They all Ran Wild: the story of pests on the land in Australia*. Angus & Robertson, Sydney.
- RYAN, R. M., 1963. Extension of range of *Pesudomys apodemoides*. *Victorian Nat.* 79: 363.
- SAUNDERS, G. R. & GILES, J. R., 1977. A relationship between plagues of the house mouse, *Mus musculus* (Rodentia: Muridae) and prolonged periods of dry weather in south-eastern Australia. *Aust. Wildl. Res.* 4: 151-157.
- SEEBECK, J. H. & HAMILTON-SMITH, E., 1967. Notes on a wintering colony of bats. *Victorian Nat.* 84: 348-351.
- SMITH, M., 1971. Small fossil vertebrates from Victoria Cave, Naracoorte, South Australia. I. Potoroinae (Macropodidae), Petauridae and Burramyidae (Marsupialia). *Trans. R. Soc. S. Aust.* 95: 185-198.
- SMITH, M., 1972. Small fossil vertebrates from Victoria Cave, Naracoorte, South Australia. II. Peramelidae, Thylacynidae and Dasyuridae (Marsupialia). *Trans. R. Soc. S. Aust.* 96: 125-137.
- SPECHT, R. L., ROE, E. M. & BROUGHTON, V. H., 1974. Conservation of major plant communities in Australia and Papua New Guinea. *Aust. J. Bot. Suppl.* No. 7.
- STODDART, D. M. & BRAITHWAITE, R. W., 1979. A strategy for utilization of regenerating heathland habitat by the Brown Bandicoot (*Isodon obesulus*, Marsupialia, Peramelidae). *J. Anim. Ecol.* 48: 165-179.
- TIDEMANN, C. R., 1967. Some mammal remains from cave deposits in the south-east of South Australia. *S. Aust. Nat.* 42: 21-27.
- TIDEMANN, C. R. & WOODSIDE, D. P., 1978. A collapsible bat-trap and a comparison of results obtained with the trap and with mist nets. *Aust. Wildl. Res.* 5: 355-362.
- WAINER, J. W., 1976. Studies of an island population of *Antechinus minimus* (Marsupialia, Dasyuridae). *Aust. Zoologist* 19: 1-7.
- WAINER, J. W. & GIBSON, R. J., 1976. Habitat of the Swamp Antechinus in Victoria. *Victorian Nat.* 93: 253-255.
- WAKEFIELD, N. A., 1963. Mammal remains from The Grampians, Victoria. *Victorian Nat.* 80: 130-133.
- WAKEFIELD, N. A., 1964. Recent mammalian sub-fossils of the basalt plains of Victoria. *Proc. R. Soc. Vict.* 77: 419-425.
- WAKEFIELD, N. A., 1964a. Mammal sub-fossils from near Portland, Victoria. *Victorian Nat.* 80: 39-45.
- WAKEFIELD, N. A., 1966. Mammals recorded for the Mallee, Victoria. *Proc. R. Soc. Vict.* 79: 627-633.
- WAKEFIELD, N. A., 1967. Preliminary report on McEachern's Cave, S.W. Victoria. *Victorian Nat.* 84: 363-383.
- WAKEFIELD, N. A., 1969. Interpretation of data from McEachern's Cave, S.W. Victoria. *Helictes* 7: 17-20.
- WAKEFIELD, N. A., 1970. Notes on the glider-possum, *Petaurus australis* (Phalangeridae, Marsupialia). *Victorian Nat.* 87: 221-236.
- WAKEFIELD, N. A., 1971. The Brush-tailed Rock-wallaby (*Petrogale penicillata*) in Western Victoria. *Victorian Nat.* 88: 92-102.
- WAKEFIELD, N. A., 1974. Mammals of Western Victoria. In *The Natural History of Western Victoria*, Douglas, M. H. & O'Brien, L., eds, Western Victorian Sub-branch, Aust. Inst. Ag. Sci., Horsham, 35-51.

- WALLIS, R. & BAXTER, G., 1980. The Swamp *Antechinus* (*Antechinus minimus maritimus*)—notes on a captive specimen. *Victorian Nat.* 97: 211-213.
- WATSON, I. GARNET, J. R., LEE, R. D., BURKE, A. & CUDMORE, F. A., 1947. The proposed Glenelg National Forest and Sanctuary. *Victorian Nat.* 64: 62-73.
- WATTS, C. H. S. & ASLIN, H. J., 1981. *The Rodents of Australia*. Angus & Robertson, Sydney.
- WARNEKE, R. M., 1971. Field study of the Bush Rat (*Rattus fuscipes*). *Wildl. Contrib. Vict.* 14.
- WARNEKE, R. M., 1978. The status of the Koala in Victoria. In *The Koala: proceedings of the Toronga Symposium*, Bergin, T. J. ed., Zoological Parks Board, New South Wales, Sydney.
- WILLIS, J. H., 1970. *A Handbook to Plants in Victoria, Volume I. Ferns, Conifers and Monocotyledons*. 2nd Ed. Melbourne University Press, Melbourne.
- WILLIS, J. H., 1972. *A Handbook to Plants in Victoria, Volume II. Dicotyledons*. Melbourne University Press, Melbourne.
- WOOLLEY, P., 1966. Reproduction in *Antechinus* spp. and other dasyurid marsupials. *Symp. Zool. Soc. Lond.* 15: 281-294.

APPENDIX 1

ANNOTATED LIST OF MAMMALS

Nomenclature and taxonomic order follow Australian Mammal Society (1980) and names of plants follow Willis (1970, 1972). Vegetation alliances listed under habitat include only those in which we recorded the species unless otherwise stated. Specimen numbers prefixed by C refer to specimens held in the NMV, those listed under Specimens were taken during this survey. FWD indicates Fisheries and Wildlife Division, Ministry for Conservation. Previous records are listed by Gedye *et al.* (1977) and Evans and Dixon (1980). For species not recorded during our survey the most recent record from the survey area is given.

TACHYGLOSSIDAE

1. *Tachyglossus aculeatus*—Short-beaked Echidna

Abundance and distribution. Uncommon and widespread. Only 18 observed during our survey, 5 of which were road mortalities. Most sightings (66%) were in spring and summer. Observed in 12 cells although characteristic diggings were found in 43% of all cells in which trapping took place.

Habitat. All terrestrial environments except closed-scrub, closed-heath and extensive tracts of farmland.

ORNITHORYNCHIDAE

2. *Ornithorhynchus anatinus*—Platypus

Abundance and distribution. Common and restricted to streams. Recorded from the Glenelg, Wannon (B. Burchell *pers. comm.*) Surrey (N.F.L. 1947) and Wimmera Rivers (W. Middleton *pers. comm.*); from Bryon Creek at Coleraine; Darlots Creek (Keiller 1940) and Lake Monibeong (NPS records). Not observed during our survey although several recent sightings were reported by local naturalists. The zoogeographic interest of the isolated population in the Wimmera River has been mentioned by Emison *et al.* (1978).

Habitat. Aquatic. Requires permanent freshwater with a mud or gravel substrate and friable banks in which to construct burrows. In the Glenelg River it occurs in tidal, brackish water as far downstream as Sapling Creek some 30 km from the mouth (J. Davies *pers. comm.*) although Watson *et al.* (1947) reported a sighting about 1.6 km from the mouth.

DASYURIDAE

3. *Antechinus flavipes*—Yellow-footed Antechinus

Abundance and distribution. Widespread and common but absent from the Little Desert and rare on the Volcanic Plains. A specimen labelled 'Kaniva area' (NMV C15870) actually came from 20 km S of Kaniva on the southern edge of the Little Desert (C. Crouch *pers. comm.*).

Habitat. Brown Stringybark open-forest and low open-forest,

all woodland types, Silver Banksia open-heath and Desert Banksia open-heath on the Wimmera Plains. Trapping rates were highest in Manna Gum woodland (8%) and lowest in Desert Banksia open-heath (4%).

Breeding. Females with pouch young were trapped between 15 and 23 August. All females had ten nipples, and ten pouch young were recorded in all five litters examined. By 14 November females were still lactating but had no young in the pouch. Male die-off (Braithwaite & Lee 1979a) was complete by 15 August, the last male being trapped on 6 July and one was found dead on 17 August (FWD 12016). First year males were first trapped on 28 January.

Specimens. C13176, C14052, C22268, C24363-9, C24548, C25208, FWD 12016.

4. *Antechinus minimus*—Swamp Antechinus

Abundance and distribution. Restricted to the Volcanic Plains near the coast and those parts of the Coastal Plains having >650 mm rainfall per year. Locally common.

Habitat. Brown Stringybark open-forest with wet heath understorey, Silver Banksia closed-heath, Coast Wattle open-scrub and Blue Tussock Grass closed-grassland. Only 50% of trap sites were in treeless heath (cf. Wainer & Gibson 1976) and mean trapping success rates were similar in Brown Stringybark open-forest (8%) and treeless Silver Banksia closed-heaths (7%). Floristic data were collected at 14 of the 22 capture sites. Commonly occurring species of plants from these sites are listed below. Many of these species were also dominant in heaths preferred by *A. minimus* at Cape Liptrap, South Gippsland (Braithwaite *et al.* 1978).

Species	% Occurrence
<i>Leptospermum juniperinum</i>	85
<i>Xanthorrhoea minor</i>	86
<i>Banksia marginata</i>	71
<i>Melaleuca squarrosa</i>	71
<i>Leptocarpus tenax</i>	64
<i>Sprengelia incarnata</i>	43
<i>Casuarina pusilla</i>	36
<i>Eucalyptus baxteri</i>	36

Breeding. Little trapping took place within the range of this species during the supposed breeding period (June-September). A female trapped on 1 June (NMV C22267) had a pouch similar to other *Antechinus* spp. at the time of mating (Woolley 1966), and independent young were trapped between 13 and 16 November. Assuming the age of weaning is roughly 14 weeks (Wallis & Baxter 1980), mating must have occurred before early August. Sex ratios of trapped animals in March, May and June were 1.7:1 (12♂, 7♀), 1.6:1 (8♂, 5♀) and 1.7:1 (15♂,

9 ♀) respectively, showing a similar preponderance of males to that found by Wainer (1976). No males were trapped in July. All females had 8 nipples. Thus the breeding cycle in southwestern Victoria appears similar to that on Great Glennie Island (Wainer 1976) and in South Gippsland (Norris *et al.* 1979, Wallis & Baxter 1980).

Specimens. C22267, C24345-7, FWD 12398.

5. *Antechinus stuartii*—Brown Antechinus

Abundance and distribution. Restricted to the Volcanic Plains near the coast and high rainfall (> 800 mm per annum) areas of the Coastal Plains where it is locally common. Not recorded in South Australia.

Habitat. Messmate open-forest and Silver Banksia closed-heath.

Breeding. Trapping took place within the range of this species only in October and March. Male die-off was complete before October when females had nest young. One independent male juvenile was captured on 12 October. All females examined had 6 nipples.

Specimens. C13559, C24358, C24382.

6. *Antechinus swainsonii*—Dusky Antechinus

Abundance and distribution. Restricted to the Volcanic Plains near the coast and high rainfall (> 800 mm per annum) areas of the Coastal Plains. Locally common. Not recorded from South Australia.

Habitat. Messmate open-forest and Silver Banksia closed-heath.

Breeding. Trapping within the range of this species began on 12 October when male die-off was complete. Lactating females without pouch young were captured between 12 and 19 October, as were independent juveniles. All females had 8 nipples.

Specimens. C13558, C24379-81, FWD 12152, FWD 12226.

7. *Dasyurus maculatus*—Tiger Quoll

Abundance and distribution. Restricted to the high rainfall (> 750 mm per annum) areas of the Volcanic Plains except for a specimen from Hamilton in 1958 (NMV C2806). Uncommon in The Stones State Faunal Reserve, rare in the Heywood area. The population in The Stones State Faunal Reserve is one of the most stable and accessible in Victoria, the only other areas where regular reports are made being the upper Snowy River and Otway Ranges.

Habitat. Manna Gum woodland with an understorey of *Pteridium esculentum* and grasses covering jumbled basalt boulders. Occasionally in Messmate open-forest and Manna Gum open-forest in Cobobboonee Forest. During the breeding season from May to late July wandering adult males occur in farmland surrounding the main habitat.

8. *Dasyurus viverrinus*—Eastern Quoll

Abundance and distribution. Formerly widespread but no longer present. Listed by Edward Townsend, an early Nhill resident, as occurring in the Nhill district in the 1860s (Blake 1976, p. 2). Reported to have killed young *Ostriches Struthio camelus* being bred at Longerenong Station in 1867 (Rolls 1969, p. 251).

Habitat. Presumably most woodland alliances.

9. *Phascogale tapoatafa*—Tuan

Abundance and distribution. Restricted and rare. Recorded only on the Tablelands and Wimmera Plains where small remnants of Crown Land and roadside and streamside reserves provide the only remaining habitat. During our survey a road-killed animal was found at Apsley and we were told of one captured 13 km WNW of Edenhope and 2 killed by cats near Balmoral. Also recorded from: Telangatuk East (FWD 785), Bulart (FWD D587), 29 km N of Casterton (C13969), 23 km N of Coleraine (C3135), Brit Brit (C2475), Casterton (C2655) and

Coleraine (FWD DB251). The provenance of two specimens labelled Portland (C2042-3) is uncertain. They may have come from further north.

Habitat. All woodland alliances.

Specimen. C13164.

10. *Sminthopsis erassicaudata*—Fat-tailed Dunnart

Abundance and distribution. Widespread and uncommon in the Tablelands and Wimmera Plains; rare in the Little Desert. Not recorded from the Coastal or Volcanic Plains. Only one captured during our survey in a pitfall in the Little Desert 16 km S of Gerang Gerung. Probably more common than our results suggest as it mostly inhabits farmland.

Habitat. Desert Banksia open-heath. Usually associated with farmland. Morton (1978) claims that it does not occur in closed or open-scrub. However, the only animal captured during our survey was collected in low open-heath dominated by *Casuarina muellerana*, *Xanthorrhoea australis* and *Hibbertia* sp. on a dune adjacent to a small claypan with Yellow Gum woodland.

Specimen. C22264.

11. *Sminthopsis leucopus*—White-footed Dunnart

Abundance and distribution. Restricted to areas of the Volcanic Plains and Coastal Plains having > 700 mm rainfall per annum. Not recorded from adjacent parts of South Australia. Probably more common than records suggest as it is difficult to trap.

Habitat. Brown Stringybark open-forest with a dense heath understorey and Silver Banksia closed-heath. Dominant plant species from our trapping site were: *Acacia verticillata*, *Banksia marginata*, *Hibbertia* sp. *Leptocarpus tenax*, *Leptospermum juniperinum*, *Melaleuca squarrosa*, *Sprengelia incarnata* and *Xanthorrhoea minor*. Morton *et al.* (1980) describe the habitat from the Mt Clay site and Cockburn (*pers. comm.*) trapped and released several individuals on Bald Hill, Lower Glenelg National Park in dense wet heath.

Specimen. C22668.

12. *Sminthopsis murina*—Common Dunnart

Abundance and distribution. Restricted to the Tablelands and Wimmera Plains. All records come from the Edenhope-Chetwynd area where the mean annual rainfall is between 700 and 550 mm (cf. Morton *et al.* 1980); we consider its presence in the lower Glenelg River area to be unconfirmed as specimen C14017 is intermediate and the habitat is atypical. Only one (0.1%) was trapped 15 km SW of Edenhope, and the remains of another were found in a fox stomach (FWD 8993) taken 10 km W of Chetwynd in March 1973. Also recorded from 24 km N of Casterton (C14020, C14028) in 1967 and from 23 km NNW of Coleraine in 1962 (C4510). Not recorded from the Little Desert although it occurs in the Big Desert to the north and at similar latitudes in South Australia (Morton *et al.* 1980, fig. 2).

Habitat. Brown Stringybark open-forest. Our capture was made in a thicket of *Leptospermum juniperinum* with a sparse ground cover of *Hibbertia fasciculata*, *Lepidosperma longitudinale* and *Hypolaena fastigiata*. This thicket was surrounded by Brown Stringybark open-forest with a sparse heath understorey dominated by *Xanthorrhoea minor*, *Brachyloma daphnoides*, *Leucopogon virgatus* and *Calytrix tetragona*.

Specimens. C24357, FWD 8993.

PERAMELIDAE

13. *Isodood onhesulus*—Southern Brown Bandicoot

Abundance and distribution. Widespread and common on the Coastal Plains and Volcanic Plains. The most northerly record in the survey area (37°10'S) approximates the 600 mm isohyet. Not recorded from adjacent parts of South Australia.

Habitat. Messmate open-forest, Brown Stringybark open-forest and low open-forest, Scented Paper-bark closed-scrub and Silver Banksia closed-heath and open-heath. Not recorded in Coast Wattle open-scrub in contrast to South Gippsland (Norris *et al.* 1979) nor in Desert Banksia open-heath. Trapping success in Brown Stringybark open-forest (3.7%) was similar to that in Silver Banksia closed-heath (3.3%).

Breeding. Trapping within the range of *I. obesulus* took place in March, May, June, July, August, October and November. Pouch young were present in June, October and November but not in July and August when few females were trapped. Mean litter size was 2.5 ($n=6$). Stoddart and Braithwaite (1979) found a distinct breeding peak between July and December at Cranbourne, Victoria and a mean litter size of 3 but claim that breeding occurs year round in Western Victoria.

Specimens. C22269, C24374-5.

PHALANGERIDAE

14. *Trichosurus vulpecula*—Common Brushtail Possum

Abundance and distribution. Widespread and common except in the Little Desert where it is rare. The most widespread arboreal mammal in the survey area (Table 5).

Habitat. All open-forest and woodland types and farmland with trees. Of the 164 animals trapped or spotlighted during our survey 44% were in River Red Gum woodland, 16% in Brown Stringybark open-forest, 4% in Brown Stringybark low open-forest, 16% in Manna Gum open-forest, 8% in Manna Gum woodland, 3% in Messmate open-forest, 6% in Yellow Gum woodland, 3% in *Casuarina luehmannii* in farmland and 1% in *Eucalyptus cladocalyx* plantation.

BURRAMYIDAE

15. *Acrobates pygmaeus*—Feathertail Glider

Abundance and distribution. Widespread and uncommon. Not recorded in the Little Desert or on the Coastal Plains. Specimen records are from Portland, Gorae Forest and 24 km NW of Casterton (Evans & Dixon 1980); Golter South (Gedyc *et al.* 1979); Frances (SAM M2088); and Lower Norton (FWD 12273). Sight records are from Coleraine in 1975 (B. Burchell *pers. comm.*), 3 km NE of Balmoral in March 1980 (I. Temby *pers. comm.*) and 4 km E of Comaum in 1974 (A. Roper *pers. comm.*). The provenance of a record from the Kaniva area (Wakefield 1966) remains uncertain.

Habitat. Recorded in Yellow Gum woodland (I. Temby *pers. comm.*), Messmate open-forest in Gorae Forest (V. Peterson *pers. comm.* to J. Seebeck), in an old building in Coleraine (B. Burchell *pers. comm.*) and in a fruit and vegetable garden with nearby River Red Gum woodland at Lower Norton. Brown Stringybark open-forest may be unsuitable.

16. *Cercartetus concinnus*—Western Pygmy-possum

Abundance and distribution. Widespread and probably common in the Little Desert, rare on the Wimmera Plains (Emison *et al.* 1978) and absent from elsewhere in the survey area. All records are from areas with <600 mm rainfall per annum. Recorded in only 2 grids during our survey. It does not readily enter cage traps and was recorded by drift fence pitfall trapping and the chance finding of skeletal remains. Probably more common than records suggest.

Habitat. Recorded in Brown Stringybark low open-forest and Yellow Gum woodland. Two individuals were captured in pitfalls in Yellow Gum woodland with an understorey of *Melaleuca wilsonii* and nearby heath with *Triodia* sp. Another was found dead in an old building surrounded by Brown Stringybark low open-forest.

Breeding. A female examined on 30 March 1970 on the edge of the Little Desert S of Broughtons Waterhole had 5 pouch young.

Specimens. C21025, C22245.

17. *Cercartetus nanus*—Eastern Pygmy-possum

Abundance and distribution. Restricted to the high rainfall (>800 mm per annum) areas of the Volcanic Plains where it is uncommon. Only 1 (0.1%) trapped during our survey, 5 km NNE of Mt Kincaid in Lower Glenelg National Park. Previous specimen records are from Portland, Surrey River west of Portland, Gorae area and Mt Richmond (Evans & Dixon 1980). A specimen from Edenhope (C2471) registered as *C. nanus* is actually *C. coucinnus* (L. Huxley *pers. comm.*).

Habitat. Messmate open-forest, Manna Gum open-forest and Silver Banksia closed-heath with emergent eucalypts. The animal trapped during our survey was captured on the ground in closed-heath dominated by *Casuarina pusilla*, *Leptospermum juniperinum*, *L. myrsinoides*, *Hypolaena fastigiata*, *Xanthorrhoea australis*, *Banksia marginata*, *Melaleuca squarrosa*, *Personia juniperina* and *Leucopogon australis* with emergent *Eucalyptus nitida*.

Specimen. C24378.

PETAURIDAE

18. *Petaurus australis*—Yellow-bellied Glider

Abundance and distribution. Restricted to the Volcanic Plains, Coastal Plains and south Wimmera Plains where the mean annual rainfall exceeds 600 mm. The most northerly record during our survey was 14 km SW of Edenhope. Formerly present in streamside Manna Gum woodland in the Kanawinka area (R. Keeble *pers. comm.*).

Habitat. Manna Gum open-forest, Messmate open-forest, Brown Stringybark open-forest, particularly where gum-barked eucalypts (*E. viminalis*, *E. aromaphloia* and *E. ovata*) are also present and Yellow Gum woodland. The 58 trees with incisions made by this species, "feed-trees" (Wakefield 1970), included *E. viminalis* (45%), *E. leucoxylon* (33%), *E. obliqua* (16%), *E. baxteri* (2%), *E. pauciflora* (2%) and *E. aromaphloia* (2%).

19. *Petaurus brevicaeps*—Sugar Glider

Abundance and distribution. Widespread and uncommon; becomes progressively rarer to the north. Not recorded north of the Little Desert.

Habitat. All open-forest and woodland alliances except in the Little Desert where they appear to be restricted to Yellow Gum woodland. Most common in open-forest or woodland with a tall shrub understorey including *Acacia mearnsii* and *Banksia marginata*. Of the seven observed during our survey three were in Manna Gum open-forest and one was in each of River Red Gum woodland, Yellow Gum woodland, Messmate open-forest and Brown Stringybark open-forest.

20. *Pseudocheirus peregrinus*—Common Ringtail Possum

Abundance and distribution. Restricted to the Volcanic Plains, Coastal Plains, Tablelands and Mt Arapiles in the Wimmera Plains. Common in the south becoming progressively less common to the north. Not recorded in the Little Desert and the only population on the Wimmera Plains is on Mt Arapiles. All records, except those from Mt Arapiles, fall within the 650 mm isohyet. This species was the most commonly observed arboreal mammal although it was recorded in only 36% of cells where spotlighting occurred (Table 5).

Habitat. All open-forest alliances, River Red Gum woodland, Manna Gum woodland and Silver Banksia open-heath with emergent eucalypts. Of the 171 animals recorded 48% were in Manna Gum open-forest, 25% in Brown Stringybark open-forest, 19% in Messmate open-forest, 3% in River Red Gum woodland, 3% in Manna Gum woodland and 0.6% in Silver Banksia open-heath with emergent *Eucalyptus nitida*.

MACROPODIDAE

Genus *Macropus*

Difficulties in field identification of *Macropus* spp. in western Victoria have been discussed by Poole (1973), Emison *et al.* (1978) and Poole *et al.* (1980). Two species (*M. fuliginosus* and *M. rufogriseus*) occur widely in the survey area and *M. giganteus* is restricted to the south. *M. rufogriseus* is distinctive in colour and form. However, great difficulty was experienced in distinguishing between *M. giganteus* and *M. fuliginosus*. After careful field observations and the examination of numerous road-casualties we consider that *M. giganteus* and *M. fuliginosus* are sympatric between about 37°35'S and 38°00'S (see also Poole 1977). Within this zone our specific identifications are not certain and the distributions shown are provisional. Morphometric data from a large series of skulls would be necessary to accurately determine the extent of sympatry (Poole *et al.* 1980).

21. *Macropus fuliginosus*—Western Grey Kangaroo

Abundance and distribution. Widespread and common north of about 38°S. Uncommon on the Tablelands where little native vegetation remains. Recorded in 60% of cells surveyed with chance sightings in a further 7.

Habitat. Brown Stringybark open-forest and low open-forest, all woodland alliances, Broom Honey-myrtle open-scrub, Yellow Mallee open-scrub, all open-heath alliances, farmland adjacent to uncleared land and the edges of pine plantations.

Specimens. C24376, FWD 8995.

22. *Macropus giganteus*—Eastern Grey Kangaroo

Abundance and distribution. Restricted to the Volcanic Plains and Coastal Plains south of about 37°35'S, where it is common. Recorded in 16% of cells surveyed with chance sightings in a further 5.

Habitat. All open-forest alliances, River Red Gum woodland, Manna Gum woodland, Coast Wattle open-scrub, Silver Banksia open-heath, farmland adjacent to uncleared land and the edges of pine plantations.

23. *Macropus greyi*—Toolache Wallaby

Abundance and distribution. Extinct. Formerly locally common in southeastern South Australia (Jones 1924) and, possibly, adjacent parts of Victoria. Evidence of its presence in Victoria since European settlement appears to be based entirely on a footnote in Finlayson (1927, p. 366) as Jones (1924) considered it endemic to South Australia.

Habitat. Described by Finlayson (1927) as 'essentially clear country, avoiding heavy timber and thick scrub.' It was most abundant in swampy depressions with *Lepidosperma laterale*, *Xanthorrhoea minor*, *Poa* sp. and *Themeda australis* with isolated clumps of *Banksia marginata* and *B. ornata* (Finlayson 1927).

24. *Macropus rufogriseus*—Red-necked Wallaby

Abundance and distribution. Widespread and common on the Volcanic Plains. Also recorded at Mt Arapiles and NW of Kay Swamp on the Wimmera Plains; and the Broughtons Waterhole area in the Little Desert where it is rare and restricted (cf. Gedyc *et al.* 1979). One was also observed 12 km S of Kiata in late November 1978 (P. Cheal *pers. comm.*). Recorded in 45% of cells surveyed with chance sightings in a further 8.

Habitat. All open-forest alliances, Manna Gum woodland, Yellow Gum woodland and Silver Banksia heath. Grazes in farmland adjacent to cover and in grassy firebreaks in pine plantations. In the Little Desert all our sightings were in Yellow Gum woodland around clay pans.

Specimens. C17590, C24855.

25. *Potorus tridactylus*—Long-nosed Potoroo

Abundance and distribution. Restricted to the Volcanic Plains and southern Coastal Plains where the mean annual rainfall exceeds 750 mm. Locally common.

Habitat. Messmate open-forest, Brown Stringybark open-forest and Silver Banksia closed-heath with emergent eucalypts. Invariably associated with a dense shrub layer.

Breeding. Trapping within the range of this species took place in October and March. In October, 2 of 4 females trapped had a single naked pouch young and in March, 2 of 3 females trapped had pouch young.

Specimen. C24377.

26. *Thylogale billardieri*—Red-bellied Pademelon

Abundance and distribution. Presumed extinct in Victoria. Formerly present in coastal areas (NMV records) the only records from the survey area being a specimen from Portland (C6556) and a mandible of unknown age found in a blowout on the dunes of Discovery Bay (C23668). Reasons for its decline are not clear.

Habitat. Presumably dense coastal vegetation such as Brown Stringybark open-forest, Scented Paper-bark closed-scrub and Silver Banksia closed-heath.

27. *Wallabia bicolor*—Swamp Wallaby

Abundance and distribution. Probably no longer present in the survey area. Remains have been found in several cave deposits (Table 2) and Wakefield (1964a) had evidence of its presence in the Lower Glenelg area around 1900. A recent specimen (C17568), listed by Gedyc *et al.* (1979, p. 120) as having come from Mt Elgin, was actually collected at Mt Erip (37°45'S, 143°36'E) (FWD records) and sightings in Lower Glenelg National Park (Gedyc *et al.* 1979) are considered doubtful.

PHASCOLARCTIDAE

28. *Phascolarctos cinereus*—Koala

Abundance and distribution. Widespread and uncommon in the south, the most northerly record being 37°15'S. Formerly more widespread, the present distribution reflects the FWD restocking program following the general decline of the species in the early 1900s (Warneke 1978). Between December 1952 and December 1978 approximately 192 Koalas were released in the survey area. Details are given below.

Date	No. released	Origin	Point of release
Dec. 1952	32	Phillip Island	Gorae Forest
Sep. 1953	33	Phillip Island	Tyrendarra
Dec. 1970	44	French Island	Lower Glenelg Nat. Park
Dec. 1970	44	French Island	Mt Richmond Nat. Park
Feb. 1973	15	Phillip Island	Mt Eccles Nat. Park
Nov. 1975	24	Phillip Island	Bats Ridges State Faunal Reserve

Habitat. Messmate open-forest, River Red Gum woodland and Manna Gum open-forest and woodland. Eucalypts known to be eaten (Warneke 1978) which occur in the survey area are: *E. camaldulensis*, *E. obliqua*, *E. ovata*, *E. viminalis* and *E. microcarpa*. We observed Koalas in the first 3 of these as well as *E. aromaphloia* and *E. baxteri*.

VOMBATIDAE

29. *Vombatus ursinus*—Common Wombat

Abundance and distribution. Formerly widespread along creeks throughout the Coastal Plains, e.g. Mosquito Creek (C. Halahan *pers. comm.*) and in dune swales behind Discovery Bay (J. Davies *pers. comm.*). Skeletal remains have been found at Bats Ridges State Faunal Reserve (Anon 1907, C22349) and Bridgewater Lakes (J. Seebeck *pers. comm.*). The population

at Bats Ridges died out in the early 1960s (J. Seebeck *pers. comm.*) as did a colony at Malseed Lake (N. Learmonth *pers. comm.* to J. Seebeck). Now restricted to a few small, isolated colonies in the Dorodong-Dergholm area and along Dry Creek, S.A.; animals from this colony occasionally wander to the banks of the Glenelg River as far east as Sandy Waterholes (37°59'S, 141°01'E) (J. Davies *pers. comm.*). Recently several animals from eastern Victoria were introduced to Bats Ridges State Faunal Reserve (P. Kelly *pers. comm.*). Most colonies are threatened as they are small and occur in isolated patches of bushland on freehold land.

We were directed to occupied burrows at 4 localities: 7 km NW of Dorodong; along Prospect Creek 6 km SE of Dergholm; along Wombat or Wild Pig Creek 7.3 km NNE of Dergholm (includes the population adjacent to Baileys Rocks Scenic and Recreation Reserve) and along Dry Creek 6 km NW of Nelson. In the Dergholm area the largest and most stable population is the Wombat Creek colony (R. Howlett *pers. comm.*) where numerous occupied burrows were found during our visit.

Habitat. All remaining colonies are along creeks, 2 in outcrops of Glenelg Limestone and 2 in sandy loam soils. The Dry Creek colony is in cleared pasture and Brown Stringybark open-forest; the Prospect Creek colony is in a remnant of Brown Stringybark open-forest with *Pteridium esculentum* dominating the understorey and the other 2 are in Manna Gum woodland with a tall shrub layer and grassy ground layer.

PIEROPODIDAE

30. *Pteropus scapulatus*—Little Red Flying-fox

Abundance and distribution. A rare vagrant to the survey area. Only recorded from Heywood (undated specimen C19778) and Dimboola and Quantong in November 1980 (M. Donaldson *pers. comm.*). This species is a sporadic visitor to Victoria, usually in summer and autumn.

Habitat. In Victoria usually associated with orchards or flowering eucalypts.

MOLOSSIDAE

31. *Tadarida australis*—White-striped Mastiff-bat

Abundance and distribution. Widespread but uncommon in the Little Desert and Wimmera Plains, also recorded from Brit Brit (C10738) on the Tablelands. Comprised 6% of 34 bats collected over Broughtons Waterhole, Little Desert between February and April 1970 (FWD unpubl. data).

Habitat. River Red Gum and Yellow Gum woodland, Yellow Mallee open-scrub and farmland. Requires tree hollows for shelter and breeding.

Specimen. C21026.

32. *Tadarida planiceps*—Little Mastiff-bat

Abundance and distribution. Widespread and uncommon in the Little Desert and Wimmera Plains. Also recorded from Portland in July 1970 (C17904). Comprised 6% of 34 bats collected over Broughtons Waterhole between February and April 1970 (FWD unpubl. data).

Habitat. River Red Gum and Yellow Gum woodland, Yellow Mallee open-scrub and farmland with trees. Requires tree hollows for shelter and breeding.

Specimens. C24335, C24337-9.

VESPERTILIONIDAE

33. *Chalinolobus gouldii*—Gould's Wattle Bat

Abundance and distribution. Widespread and common. The most commonly collected bat over Broughtons Waterhole, Little Desert between February and April 1970 (65% of 34 bats collected, FWD unpubl. data).

Habitat. Brown Stringybark open-forest, all woodland alliances, fringes of Yellow Mallee open-scrub and farmland with trees. Requires tree hollows for shelter and breeding.

Specimens. C24307, C24309-10.

34. *Chalinolobus morio*—Chocolate Wattle Bat

Abundance and distribution. Widespread and common, recorded from all physiographic regions. A total of 12 captured (8%) in 28% of grids trapped. Comprised 9% of 34 bats collected over Broughtons Waterhole, Little Desert between February and April 1970 (FWD unpubl. data).

Habitat. All open-forest and woodland alliances, fringes of Yellow Mallee open-scrub and farmland with trees. Requires tree hollows for shelter and breeding.

Specimens. C24304-6, C24308.

35-37. *Eptesicus* spp.

In the second half of the field survey identifications of the species described by McKean *et al.* (1978) were attempted using Hall & Richards (1979) but these are provisional and all *Eptesicus* forms are discussed together although they are mapped separately and may now be specifically identified.

Abundance and distribution. Widespread and common. *Eptesicus* spp. comprised 69.4% of all bats captured during our survey and 18% of 34 bats collected at Broughtons Waterhole, Little Desert between February and April 1970 (FWD unpubl. data). Of 102 *Eptesicus* captured 59% were clearly *E. vulturinus*, 33% probably *E. sagittula*, and 8% probably *E. regulus* (Table 4). All three species probably occur throughout the survey area.

Habitat. All open-forest and woodland alliances. All 3 species require tree hollows for shelter and breeding.

Specimens. C24871, 24872 = *E. regulus*; C24315-18, C24331-4, C24873 = *E. sagittula*; C24311-14, C24319-30, C24874 = *E. vulturinus*.

38. *Miniopterus schreibersii*—Common Bent-wing Bat

Abundance and distribution. Only recorded from the Volcanic Plains and Coastal Plains. Distribution is centred on suitable breeding caves, 4 of which occur in the survey area: Amphitheatre Cave, Fern Cave and caves in Bats Ridges State Faunal Reserve (Hamilton-Smith 1965); and Cave Hill, Heywood (CSIRO Bat-banding records). Of these, only the main cave at Bats Ridges houses a major colony with bats present year round, being used as a wintering site by part of the larger population based at Naracoorte Caves (Hamilton-Smith 1965). On 24 June 1970 an estimated 1500 bats were present in this cave (J. Seebeck *pers. comm.*). During our survey about 50 were present in Amphitheatre Cave on 18 October 1979.

Habitat. Requires caves for breeding and daytime shelter. Dwyer and Hamilton-Smith (1965) describe the structure and physical environment of maternity caves in southeastern Australia. Forages in open-forest, woodland and farmland.

Specimens. C24343-4.

39. *Myotis adversus*—Large-footed Myotis

Abundance and distribution. Recorded from the Coastal Plains and Tablelands but its actual distribution is probably wider than the few records suggest. Small numbers inhabit at least 3 caves along the lower Glenelg River—Dry Creek Cave, Amphitheatre Cave and Kates Slide Cave (McKean & Hall 1965). Seebeck and Hamilton-Smith (1967) highlighted the vulnerability to disturbance of wintering colonies.

Habitat. Characteristically found near water from which insects are scooped with the large, strongly clawed feet (Dwyer 1970). Known roosting sites include caves (McKean & Hall 1965) and beneath bridges, aqueducts, storm-water tunnels etc. (Dwyer 1970).

Specimen. C24870.

40. *Nycticeius balstoni*—Western Broad-nosed Bat

Abundance and distribution. Restricted to the Little Desert and Wimmera Plains; uncommon. Recorded only from Broughtons Waterhole (C7479) and 10 km SW of Edenhope.

Habitat. Collected in Yellow Gum woodland and Yellow Mallee open-scrub.

Specimen. C24336.

41. *Nyctophilus geoffroyi*—Lesser Long-eared Bat

Abundance and distribution. Widespread and common. Recorded from all physiographic regions. Not collected over Broughtons Waterhole in 1970 although specimens were found nearby in old buildings and beneath bark (FWD unpubl. data).

Habitat. Brown Stringybark open-forest, River Red Gum woodland, Yellow Gum woodland, Yellow Mallee open-scrub and *Pinus radiata* plantation. Requires tree hollows for shelter and breeding.

Specimens. C24340-42.

42. *Pipistrellus tasmaniensis*—Great Pipistrelle

Abundance and distribution. Only recorded from 9.5 km SSE of Dartmoor in Lower Glenelg National Park.

Habitat. Manna Gum open-forest. Elsewhere in Victoria it is confined to open-forest and tall open-forest (FWD records).

Specimens. C24300-303

MURIDAE

43. *Conilurus albipes*—Rabbit-eared Tree-rat

Abundance and distribution. Extinct. The only record from the survey area since European settlement is a specimen said to have come from Portland Bay around August 1845 (Anonymous 1846). However, Mahoney (1982) discusses the possibility that Mitchell collected a specimen between the Wannon and Stokes Rivers in 1835. May have been widespread in the survey area up until the time of settlement. Subfossil remains have been found in all bone deposits examined from the survey area: McEacherns Cave; Fern Cave; Natural Bridge at Mt Eccles and Mt Arapiles (Table 2).

44. *Hydromys chrysogaster*—Water-rat

Abundance and distribution. Common and widespread. During our survey it was recorded from the Wimmera River at Dimboola, Wannon River near Coleraine, Glenelg River near Dergholm and Nelson, Moleside Creek and Piccaninny Blue Pond. Presumably occurs in most streams, freshwater lakes and permanent swamps in the survey area (cf. Gedye *et al.* 1979).

Habitat. Aquatic, occurring in freshwater streams, lakes, permanent swamps and irrigation channels. Occurs in brackish tidal reaches of the Glenelg River.

Specimen. C22252.

45. *Mus musculus*—House Mouse

Abundance and distribution. Widespread and common, although uncommon in the Little Desert during our survey. Numbers fluctuate greatly according to seasonal food availability, level of predation, and suitability of the soil for burrowing (Newsome 1969, Saunders & Giles 1977).

Habitat. Brown Stringybark open-forest and low open-forest, all woodland types, Scented Paper-bark closed-scrub, Broom Honey-myrtle open-scrub, Coast Wattle open-scrub, all heath alliances, closed-grassland, farmland and commensal (with man) situations. Trapping rates were highest in Coast Wattle open-scrub, closed-grassland and regenerating Silver Banksia open-heath. In the Little Desert it was using different habitats to *Pseudomys apodemoides*, the only other murid present (Table 10).

Breeding. Lactating females, males with distended scrota and juveniles were trapped beside the Wimmera River during early

April 1979, and juveniles were captured along the Glenelg River in March 1980. Animals elsewhere were not breeding during the survey.

Specimens. C22241, C22243, C22262-3.

46. *Notomys mitchellii*—Mitchell's Hopping-mouse

Abundance and distribution. There is much confusion over the possible occurrence of the species in the Little Desert. Brazenor (1936) reported a sighting near Naimuk but this is not an acceptable record (see also Wakefield 1966, p. 633). NMV specimens labelled 'near Horsham' (NMV C2598-9) in fact came from the NE end of Lake Albacutya (J. M. Dixon *pers. comm.*). Burrows investigated by Brazenor in the Little Desert S of Kiata yielded no animals and were almost certainly those of *Pseudomys apodemoides* (A. J. Coventry *pers. comm.*), not *N. mitchellii* as claimed by Brazenor (1958). The confusion presumably arose because *P. apodemoides* was not known to occur in Victoria at that time (Ryan 1963). The provenance of 2 specimens labelled Kiata (NMV C2866, C2841) remains questionable and was not accepted by Wakefield (1966, 1974). A specimen reported in the Nhill Free Press (15 Nov. 1955) as *N. mitchellii* collected by J. Oldfield, 8 km SSW of Kiata, was in fact *P. apodemoides* (NMV C15076). We agree with Wakefield (1974) that records of *N. mitchellii* from the Little Desert are not authentic. The southern limit of distribution is roughly a line from the southern edge of Lake Hindmarsh to Bordertown (Wakefield 1974).

47. *Pseudomys apodemoides*—Silky Mouse

Abundance and distribution. Not known in Victoria until 1963 when specimens collected by K. Hateley in 1957 were identified (Ryan 1963). Uncommon and widespread in the Little Desert, Wail Forest Reserve and Wimmera Plains south to near Dergholm (37°20'S). Southern limit of distribution corresponds to the 650 mm isohyet.

Mean trapping success rate where captured was 4% (range 1-13). Trapping success peaked in August (5%) and April (7%) and was lowest in June (2%).

Habitat. Recorded in Desert Banksia open-heath, Brown Stringybark low open-forest on dunes, Broom Honey-myrtle open-scrub and Yellow Mallee open-scrub. In the Little Desert it was most abundant in Desert Banksia open-heath and Brown Stringybark low open-forest and was using different environments to *M. musculus* during our survey (Table 10). Cockburn (1981) showed that the species prefers dense low vegetation containing *Banksia ornata*, beneath which most burrows are located.

Breeding. Pregnant females were trapped in October, November and December, and lactating females in November. One female gave birth to three young between 13 and 16 December 1979. Juveniles were trapped in February and in April. Cockburn (1981a) also found that breeding in the Little Desert occurred in late spring and summer and related this to peaks in flowering and seed production. However, Finlayson (1944) reported the breeding peak to be late autumn and early winter in southeastern South Australia but also collected young in November. Crouch (in Happold 1976) believes that litters occur throughout the year but reproductive activity peaks in August following winter rains. Sex ratios of trapped animals varied seasonally. There was a strong female bias in April, October and November and male bias in February and August. Cockburn (1981a) also found a female bias at breeding (late spring and summer) and suggested this may enhance colonization of regenerating habitat.

Specimens. C12610-11, FWD 8990, FWD 9971-2, C14053-7, C21015, C21024, C21027-30, C22242, C22244, C22249-51, C22253-5, C24348-51.

48. *Pseudomys shortridgei*—Heath Mouse

Abundance and distribution. Restricted to the Volcanic Plains and Coastal Plains north to 37°25'S. Occurs only in areas having a mean annual rainfall of >650mm (cf. *P. apodemoides*). The entire population of this species may occur within the range shown, together with The Grampians, as the population in southwestern Western Australia may be extinct (Watts & Aslin 1981).

Habitat. Brown Stringybark open-forest and low open-forest, Silver Banksia closed-heath and open-heath, Scented Paper-bark closed-scrub. Trapping success was higher in Silver Banksia open-heath (8%) than in Brown Stringybark open-forest (4%) or Scented Paper-bark closed-scrub (4%). Floristic data were collected at 15 of the 41 trapping sites.

Commonly occurring plant species from these sites were:

Species	% Occurrence
* <i>Banksia marginata</i>	80
<i>Leptospermum juniperinum</i>	60
<i>Melaleuca squarrosa</i>	60
* <i>Epacris impressa</i>	53
<i>Xanthorrhoea minor</i>	47
* <i>Eucalyptus baxteri</i>	40
* <i>Leptospermum myrsinoides</i>	40
* <i>Xanthorrhoea australis</i>	40
* <i>Boronia pilosa</i>	33
<i>Eucalypts other than E. baxteri</i>	33
* <i>Hypolaena fastigiata</i>	33

* These species are characteristic of Silver Banksia open-heath rather than the wetter closed-heaths preferred by, for example, *Antechinus minimus*.

Breeding. This species was captured during March (7 individuals), May (4), June (44), July (14), October (15) and November (4). Little evidence of breeding was found except for one juvenile captured on 15 November and a male with scrotal testes on 26 July. Cockburn *et al.* (1981) have shown breeding to be seasonal, occurring in spring and early summer.

Specimen. C24361.

49. *Rattus fuscipes*—Bush Rat

Taxonomy. All animals captured showed the pale pelage colour and smaller dimensions and weight of the subspecies *R.f. greyi* (Warneke 1971).

Abundance and distribution. Widespread and common on the Volcanic Plains, Coastal Plains, western Tablelands and southern Wimmera Plains. Limits of distribution approximate the 650 mm isohyet. By far the most commonly trapped small mammal (Table 2).

Habitat. All open-forest alliances, Manna Gum woodland, Scented Paper-bark closed-scrub, Coast Wattle open-scrub, Silver Banksia open and closed-heath and closed-sedgeland.

Breeding. Trapping within the range of this species took place in all months except September, January and February. Lactating females were trapped in March and May, and juveniles or sub-adults between March and August. As juveniles were absent in October, November and December most breeding probably takes place in summer and autumn. Elsewhere Warneke (1971) and Robinson (1976) have recorded breeding peaks in summer.

Specimens. C13560, C22265, C24370-3, C24359.

50. *Rattus lutreolus*—Swamp Rat

Abundance and distribution. Widespread and common on the Volcanic Plains, Coastal Plains, western Tablelands and southern Wimmera Plains. Limits of distribution approximate the 650 mm isohyet.

Habitat. Messmate open-forest, Brown Stringybark open-forest and low open-forest, Manna Gum open-forest, Scented

Paper-bark closed-scrub, Coast Wattle open-scrub, Silver Banksia closed-heath, some Silver Banksia open-heath, Desert Banksia open-heath (once only), Blue Tussock Grass closed-grassland, and roadside grassland.

Breeding. Juveniles were trapped between late August and late March, a longer period than that reported by Braithwaite & Lee (1979) for Cranbourne. Braithwaite (1980) has shown that the length of the breeding season varies considerably between areas and with variations in food availability in different years.

Specimens. C22266, C24384-8, FWD 12035.

51. *Rattus rattus*—Black rat

Abundance and distribution. Usually absent in undisturbed native vegetation, but occasional local concentrations occur. Probably widespread throughout the survey area, particularly near towns and other human habitation. During our survey, recorded only from: beside the Wimmera River near Dimboola, Mt Arapiles and on coastal dunes.

Habitat. Recorded in dense stands of *Phragmites communis* beside the Wimmera River, in rock scree on Mt Arapiles and in Coast Wattle open-scrub on coastal dunes.

Specimens. C22256-61, C24360.

CANIDAE

52. *Canis familiaris*—Feral Dog and Dingo

Abundance and distribution. Widespread and uncommon. There are a few early records of dingoes from the survey area (cf. Gedye *et al.* 1979). E. Townsend reported dingoes in the Nhill area in the 1860s (Blake 1976, p. 2) and French (1888, 1888a), Le Souef (1887), D'Alton (1913) and Hamilton (1914) all mention wild dogs as pests and the methods used to destroy them. Dingoes (*C. familiaris dingo*) are now extinct in the survey area but feral dogs occasionally occur in the Little Desert (*C. Brownsea pers. comm.*), Lower Glenelg National Park and Discovery Bay Coastal Park (*J. Davies pers. comm.*) and presumably in other large tracts of bushland. Recorded in 0.8% of grids surveyed.

Habitat. Formerly all terrestrial environments. Recent records are from Yellow Mallee open-scrub, Coast Wattle open-scrub and Messmate open-forest.

53. *Vulpes vulpes*—Fox

Abundance and distribution. Widespread and common. Recorded from all physiographic regions.

Recorded in 30% of cells surveyed with chance sightings in a further 10.

Habitat. All terrestrial environments except closed-scrub and closed-heath.

54. *Felis catus*—Feral Cat

Abundance and distribution. Widespread and uncommon, more common in the south. Recorded from all physiographic regions. Free-ranging cats were observed in 20% of cells surveyed with chance observations (mainly road mortalities) in a further 14.

Habitat. Observed in all open-forest and woodland alliances, pine plantations, Coast Wattle open-scrub, Silver Banksia open-heath and farmland.

BOVIDAE

55. *Capra hircus*—Goat

Abundance and distribution. Restricted to the south-east where a feral population is centred on The Stones State Faunal Reserve (Emison *et al.* 1978).

Habitat. Manna Gum woodland with a grass and bracken understorey growing amongst tumbled granite boulders.

56. *Ovis aries*—Sheep

Abundance and distribution. Small numbers of feral sheep

were present in the Little Desert until recent years (G. Edwards *pers. comm.*). These animals were presumably escapees from nearby farms. Flocks were agisted in the Little Desert heaths during droughts up until the early 1900s when the practise was discontinued (D'Alton 1913). A feral population exists in The Stones State Faunal Reserve (Emison *et al.* 1978).

Habitat. Desert Banksia open-heath, Yellow Gum woodland and Brown Stringybark low open-forest in the Little Desert and Manna Gum woodland in The Stones State Faunal Reserve.

57. *Dama dama*—Fallow Deer

Abundance and distribution. Restricted to the area around Lake Mundi where local farmers have made several recent sightings (R. Keeble *pers. comm.*). Presumably these animals originate from a population in the Pinnaroo-Bordertown-Naracoorte area of South Australia (Bentley 1978, p. 91).

Habitat. Yellow Gum woodland and River Red Gum woodland where fresh grass and browse is available.

58. *Lepus capensis*—Brown Hare

Abundance and distribution. Widespread and generally uncommon. More common in the north. Recorded in all physiographic regions. Recorded in 5% of cells surveyed with chance sightings in a further 8. Introduced to Victoria in the 1860s (Le Souef 1965).

No information on the spread of Brown Hares into the survey area is available; however, they apparently did not

become well established until after the initial plague of rabbits had decreased in the early 1900s.

Habitat. All woodland alliances, fringes of Yellow Mallee open-scrub and farmland. Absent from areas with dense shrub or ground layers.

59. *Oryctolagus cuniculus*—European Rabbit

Abundance and distribution. Widespread and common. Recorded in 67% of cells surveyed with chance sightings in 79 others. First introduced to the Wimmera at Yannock Station, NW of Kaniva, in 1860 (Rolls 1969, p. 22). Released at Morton Plains, 25 km N of Donald, in 1866, and had reached plague proportions at Lake Buloke in 1878 by which time rabbits had spread W to the Wimmera River, E to the Avoca River and N to the Murray River (Rolls 1969, p. 37). Campbell (1884) refers to a plague in the Lawloit Range in 1884 and French (1888) states that the scrub around Serviceton was swarming with rabbits. They were a pest in the Lake Albacutya area in the 1880s (French 1888a) where large numbers were killed in the dry season with poisoned water (Le Souef 1887).

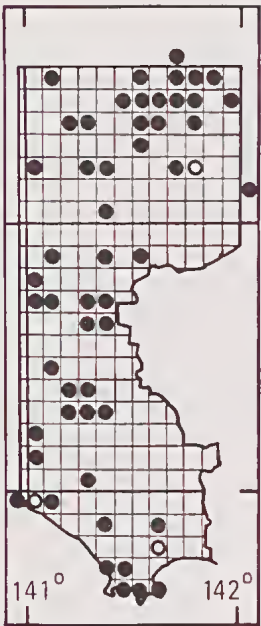
Little information is available on the spread of rabbits further south but they were present in the Stony Rises in the mid 1870s (Rolls 1969, p. 38) and had probably spread through most of the survey area by 1880 (C. Halahan *pers. comm.*).

Habitat. All terrestrial environments except those with dense ground or shrub layers.

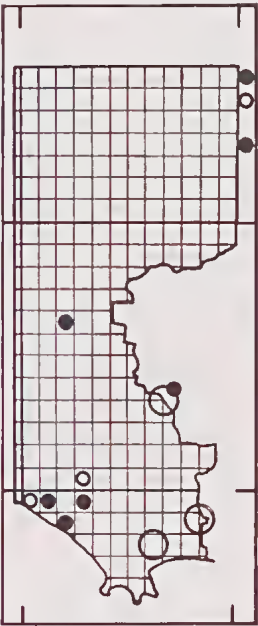
APPENDIX 2

DISTRIBUTION MAPS

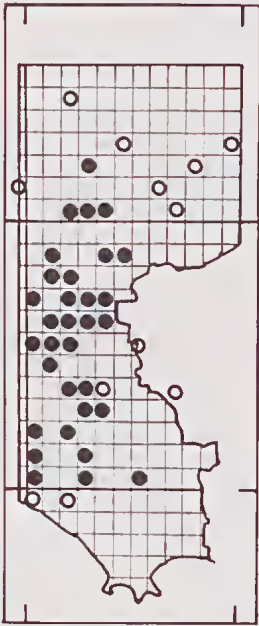
Grid lines are at intervals of 5' of latitude and longitude.
● — records made during FWD survey. ○ — records prior to October 1974. ○, ● — general locality record.



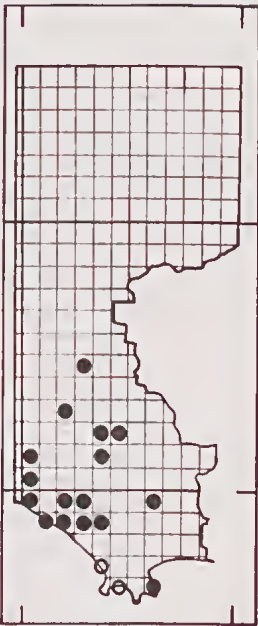
1. *Tachyglossus aculeatus*



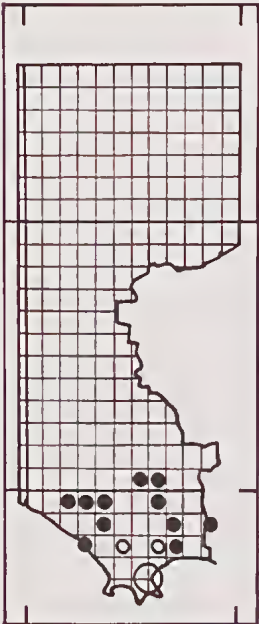
2. *Ornithorhynchus anatinus*



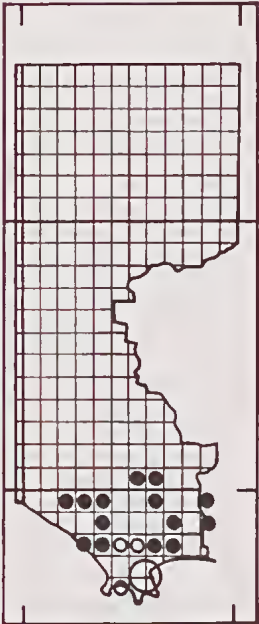
3. *Antechinus flavipes*



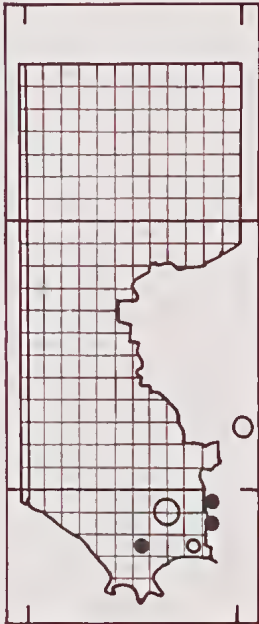
4. *Antechinus minimus*



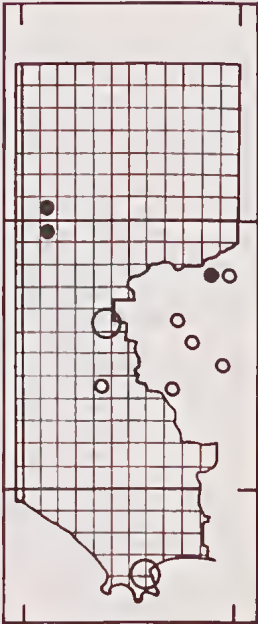
5. *Antechinus stuartii*



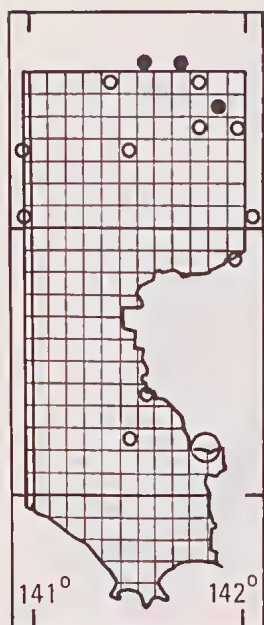
6. *Antechinus swainsonii*



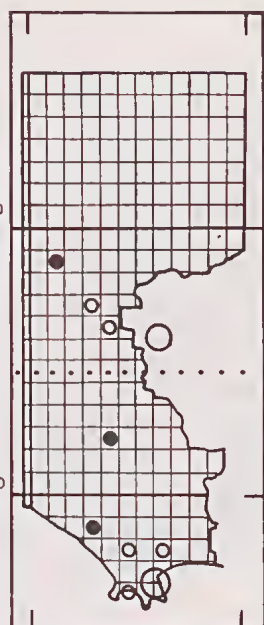
7. *Dasyurus maculatus*



9. *Phascogale tapoatafa*

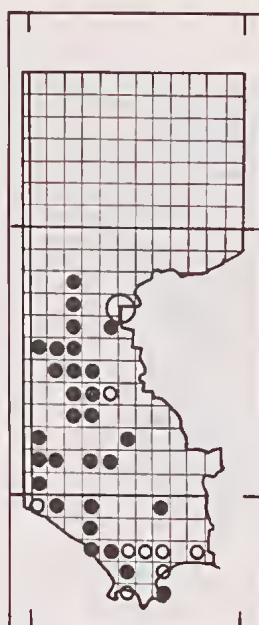


10. *Sminthopsis crassicaudata*

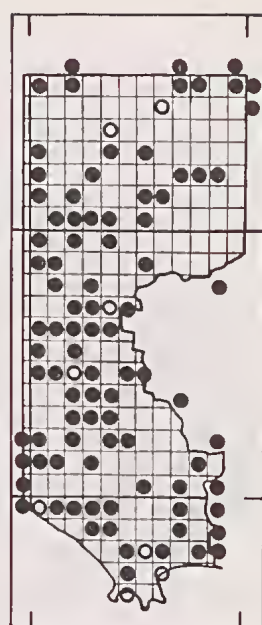


11. *Sminthopsis leucopus* (lower)

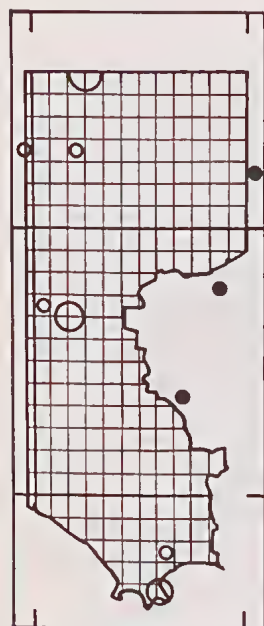
12. *S. murina* (upper)



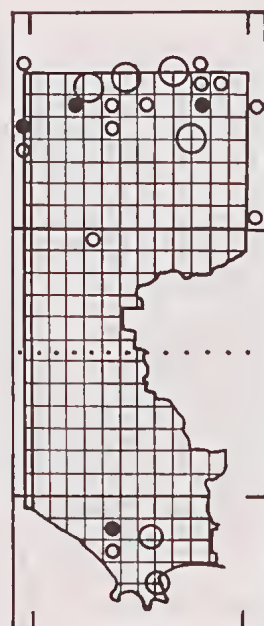
13. *Isoodon obesulus*



14. *Trichosurus vulpecula*

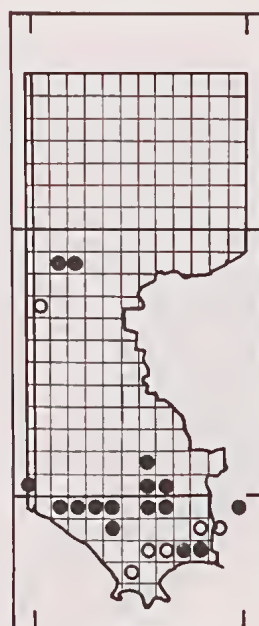


15. *Acrobatites pygmaeus*

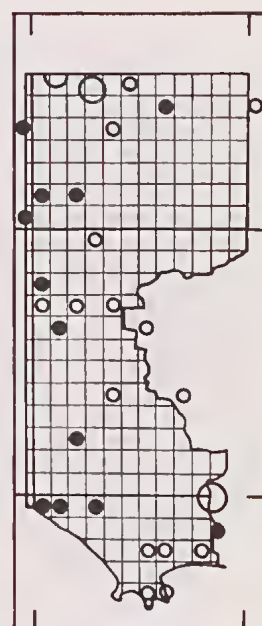


16. *Cercartetus concinnus* (upper)

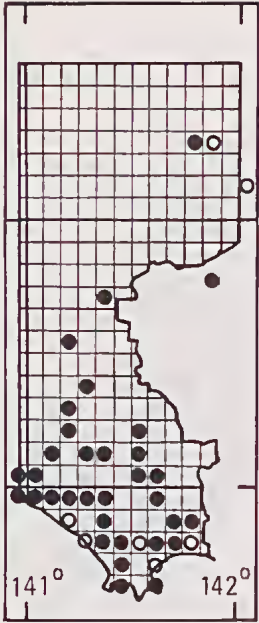
17. *C. nanus* (lower)



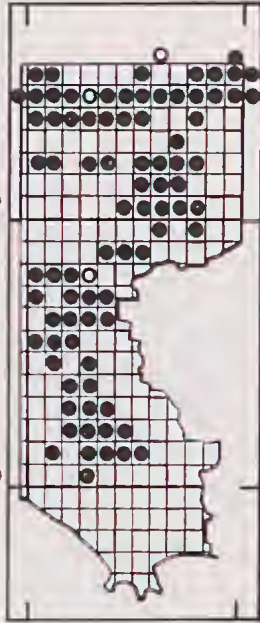
18. *Petaurus australis*



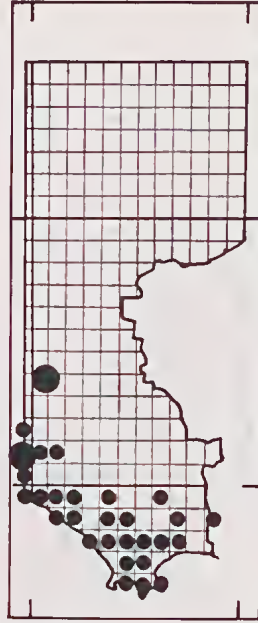
19. *Petaurus breviceps*



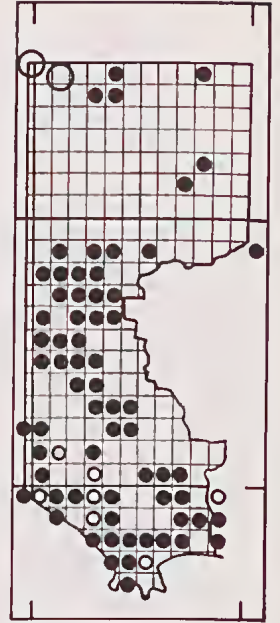
20. *Pseudocheirus peregrinus*



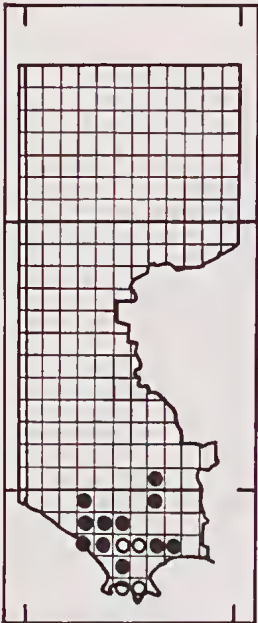
21. *Macropus fuliginosus*



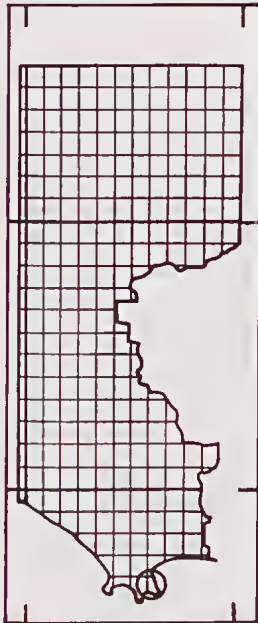
22. *Macropus giganteus*



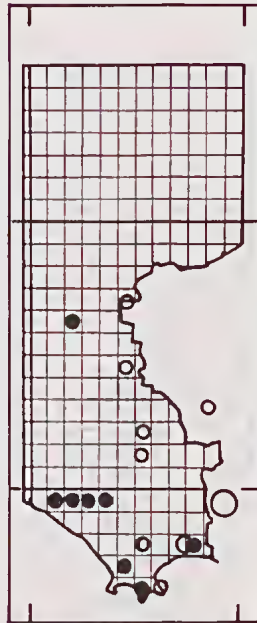
24. *Macropus rufogriseus*



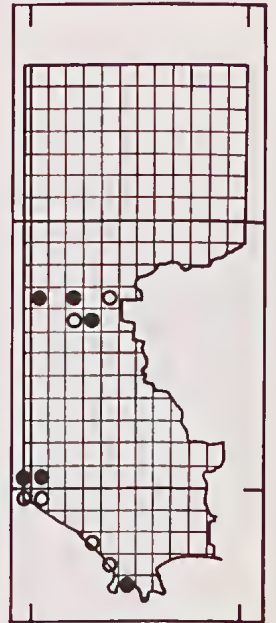
25. *Potorous tridactylus*



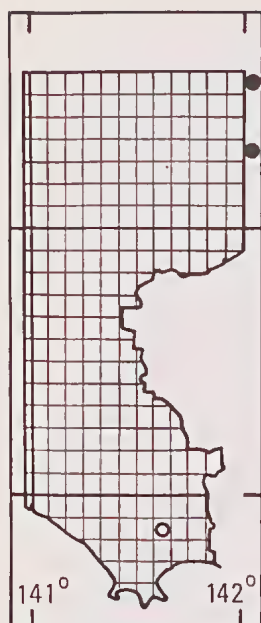
26. *Thylogale billardierii*



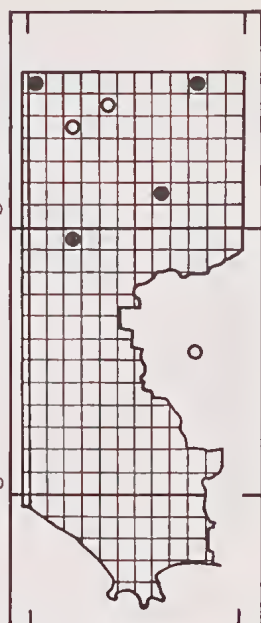
28. *Phascolarctos cinereus*



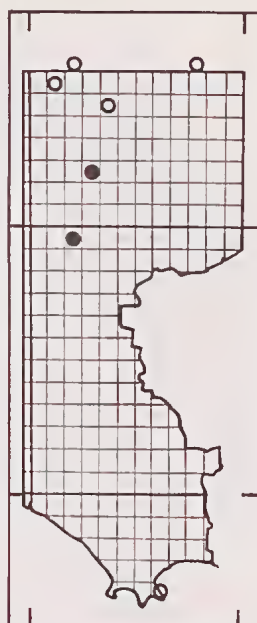
29. *Vombatus ursinus*



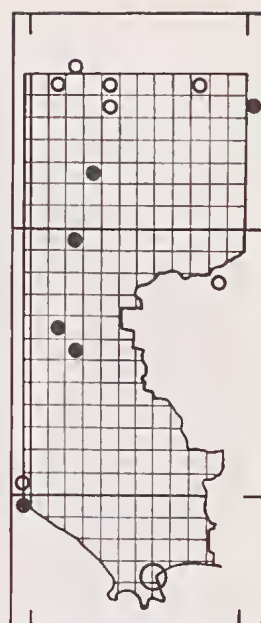
30. *Pteropus scapulatus*



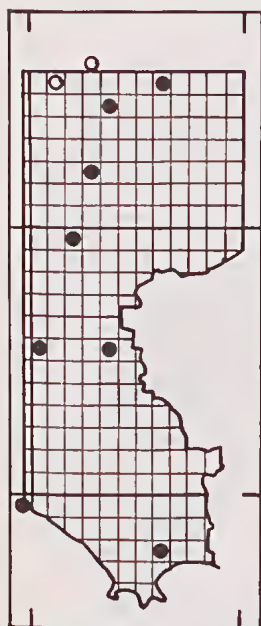
31. *Tadarida australis*



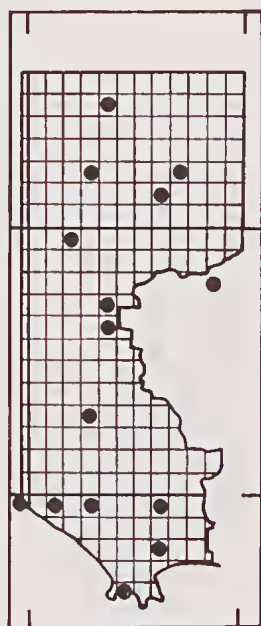
32. *Tadarida planiceps*



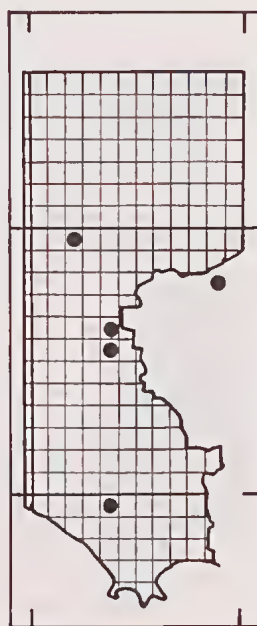
33. *Chalinolobus gouldii*



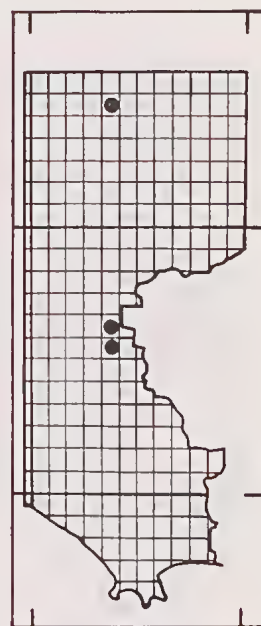
34. *Chalinolobus morio*



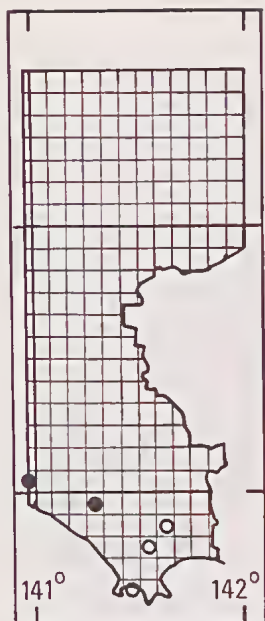
35. *Eptesicus vulturnus*



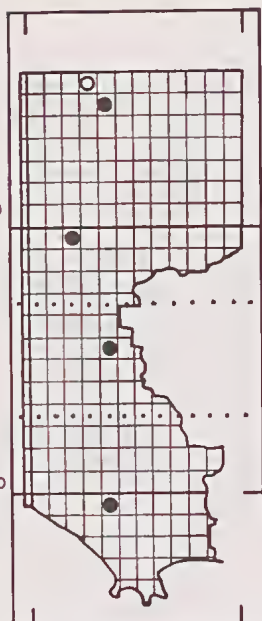
36. *Eptesicus sagittula*



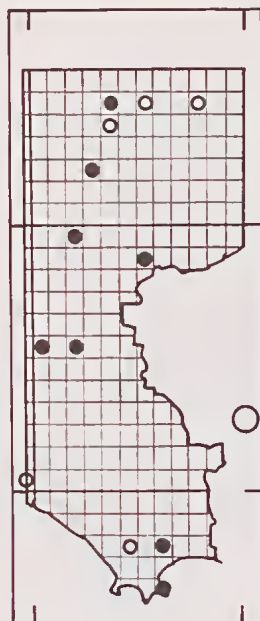
37. *Eptesicus regulus*



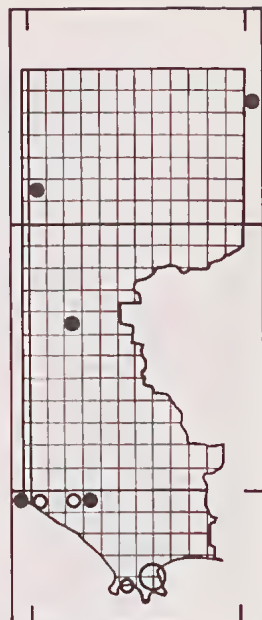
38. *Miniopterus schreibersii*



39. *Myotis adversus* (middle)



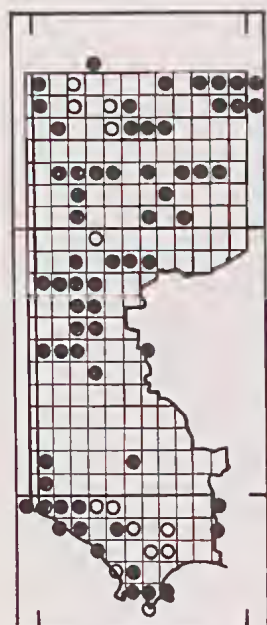
41. *Nyctophilus geoffroyi*



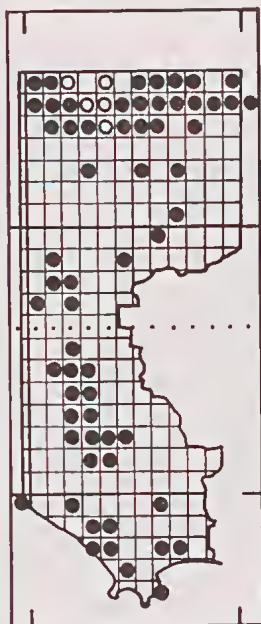
44. *Hydromys chrysogaster*

40. *Nycticeius balstoni* (upper)

42. *Pipistrellus tasmaniensis* (lower)

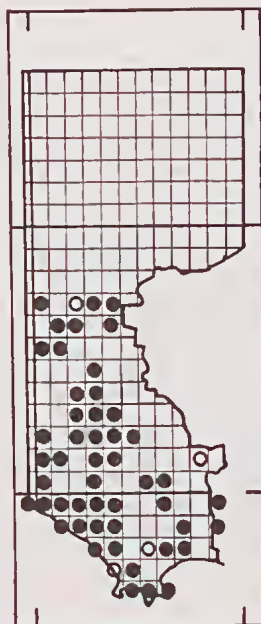


45. *Mus musculus*

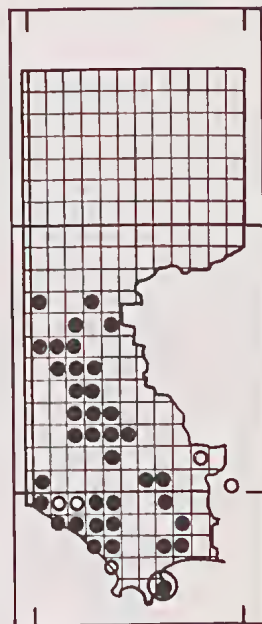


47. *Pseudomys apodemoides* (upper)

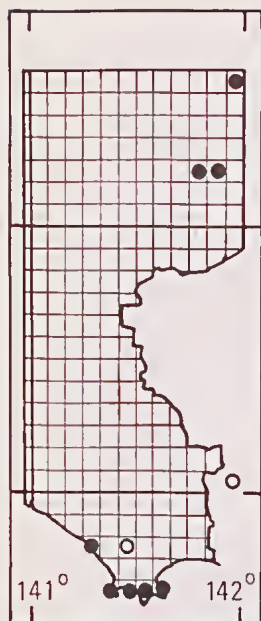
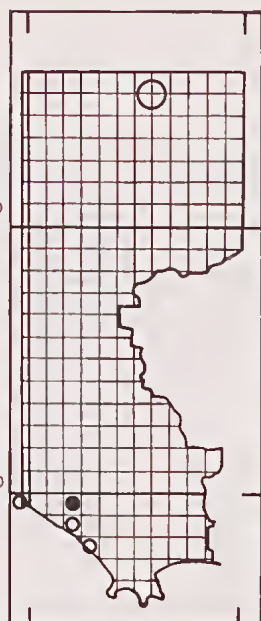
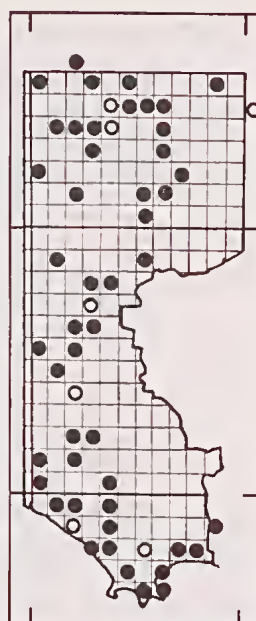
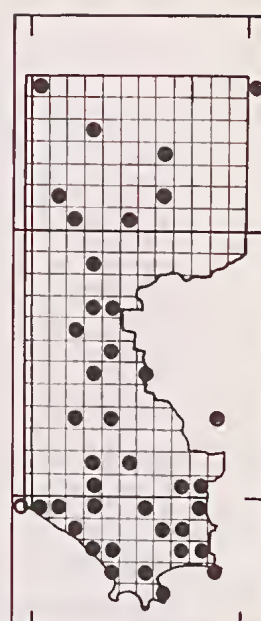
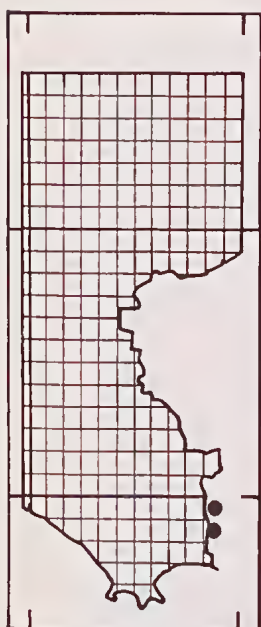
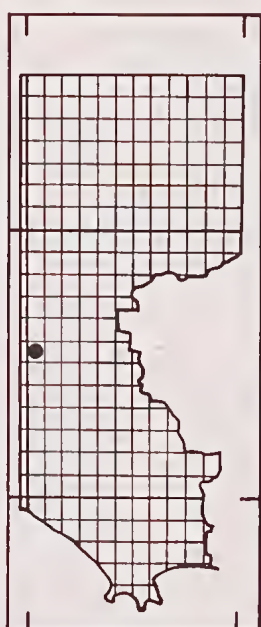
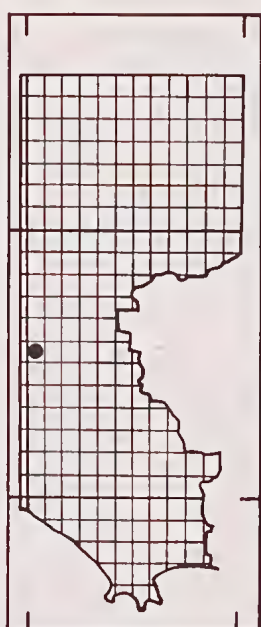
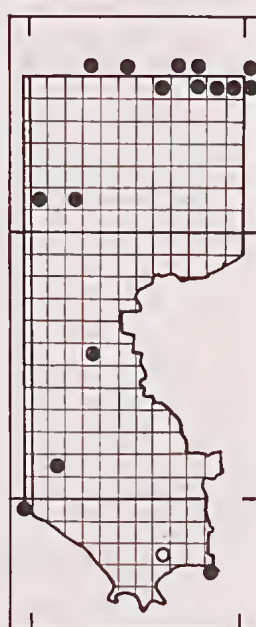
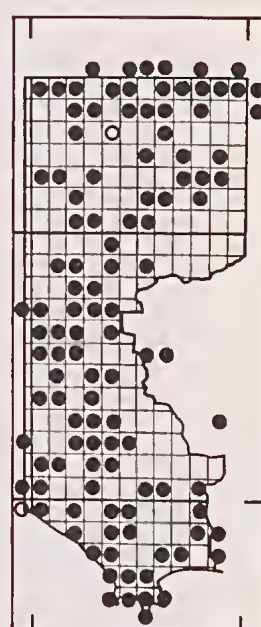
48. *P. shortridgei* (lower)



49. *Rattus fuscipes*



50. *Rattus lutreolus*

51. *Rattus rattus*52. *Canis familiaris*53. *Vulpes vulpes*54. *Felis catus*55. *Capra hircus*56. *Ovis aries*57. *Dama dama*58. *Lepus capensis*59. *Oryctolagus cuniculus*